PB 211 918

Part II
The Structure of the Steel Industry

A Study of the Economic Impact on the Steel Industry of the Costs of Meeting Federal Air and Water Pollution Abatement Requirements

COUNCIL ON ENVIRONMENTAL QUALITY
Washington, D. C.

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

July 27, 1972

BOOZ · ALLEN PUBLIC ADMINISTRATION SERVICES, Inc.
1025 Connecticut Avenue, N. W.
Washington D.C. 20036
(202) 293-3600

July 27, 1972

Mr. Eric Zausner
Council on Environmental Quality
722 Jackson Place, N. W.
Washington, D. C. 20508

Dear Mr. Zausner:

We are pleased to submit Part II of our final report on the Economic Impact of Federal Air and Water Pollution Abatement Requirements on the Steel Industry. Chapter VI, "Capacity and Demand", of this volume of our original report dated December 1, 1971, has been superseded. Capacity and Demand is now covered in Chapters I and II of Part III. Other chapters remain as originally written.

Since the end of World War II, the steel industry has grown at a rate of less than 3% per year. In the early 1960's, growth above 7% annually occurred but since 1966, industry output has leveled off, reflecting the lack of vigor in the overall economy.

Steel industry output has historically been, and remains, highly concentrated, with more than 50% of production accounted for by four companies and 75% of output by the eight largest companies. Geographic concentration of production is also significant.

a subsidiary of BOOZ · ALLEN & HAMILTON Inc.

Major steel markets include the automobile, construction, and capital goods industries. The sensitivity of these industries to changes in the level of economic activity is reflected in the sharp responsiveness of steel demand and output to cyclical trends in the general economy. Despite the cyclical nature of demand, steel prices have historically tended to remain rigid in an upward direction. Recently, however, evidence of a partial breakdown in price leadership and increasing price shading has appeared as the industry faced lagging demand and import competition.

Faced with stagnating demand, industry profits fell from a 1966 peak of $1.1 billion to $563 million in 1970. Profits for 1971 were $568 million in the face of a three million ton decrease in net steel shipments. The achievement of profits comparable to 1970 levels was based on a combination of price increases, improved productivity and management belt tightening as well as some favorable inventory adjustments and foreign tax credits. In spite of lagging profits, industry dividend payouts were not reduced and capital expenditures remained high. Thus increased reliance was placed on long-term debt for financing. In 1971, dividend cuts by most producers became necessary.

Until 1959, the U.S. was a significant exporter of steel. Subsequently, imports, spurred by increasing worldwide steel capacity and low-cost production, exceeded exports and rose rapidly to a level of

18 million tons in 1968, equal to 16.7% of the apparent domestic market. During 1969 and 1970, voluntary restraint arrangements (VRA) negotiated with Japan and the European Economic Community countries limited overall import tonnages although a switch in import product mix to higher value items has seriously hurt the domestic specialty steel industry.

During 1971, imports again rose to about 18 million tons, apparently reflecting noncompliance with VRA quotas, especially by the European Community.

Very truly yours,

Booz, Allen
Public Administration Services, Inc.

TABLE OF CONTENTS

		Page Number
	LETTER OF TRANSMITTAL	
I.	INTRODUCTION	1
II.	GROWTH OF THE STEEL INDUSTRY SINCE WORLD WAR II	3
III.	STRUCTURE OF THE DOMESTIC INDUSTRY	8
IV.	MARKETS AND PRICES	13
V.	FOREIGN TRADE AND COMPETITION	19
VI.	STEEL INDUSTRY FINANCIAL PERFORMANCE	24
VII.	STEEL PROCESSING AND ASSOCIATED WASTE PRODUCTS	33

INDEX OF EXHIBITS

		Following Page
I.	INDEX OF INDUSTRIAL PRODUCTION, TOTAL PRODUCTION, DURABLE GOODS, AND IRON AND STEEL	4
II.	PRICES OF FINISHED STEEL PRODUCTS AND ALL INDUSTRIAL COMMODITIES	5
III.	NET SHIPMENTS BY PRODUCT GROUP	5
IV.	GROWTH OF THE STEEL INDUSTRY SINCE 1953	5
V.	CONCENTRATION OF MAJOR PRODUCT SHIPMENTS	8
VI.	RAW STEEL PRODUCTION BY STATE AND REGION	9
VII.	STEEL SHIPMENTS BY MAJOR MARKET	13
VIII.	COMPARISON OF FINISHED STEEL PRICES AND TOTAL SHIPMENTS	16
IX.	PRICES AND SALES REALIZATION, FINISHED STEEL	17

INDEX OF EXHIBITS (Continued)

		Following Page
X.	COMPARISON OF TOTAL U.S. SHIPMENTS IMPORTS AND EXPORTS	19
XI.	MAN-HOURS PER TON - STEEL MILL PRODUCTS FOR THE U.S., WEST GERMANY, AND JAPAN	21
XII.	INDEXES OF OUTPUT PER MAN-HOUR, HOURLY COMPENSATION, AND UNIT LABOR COSTS IN THE IRON AND STEEL INDUSTRIES OF FOUR COUNTRIES, AND UNDERLYING DATA	22
XIII.	HOURLY EMPLOYMENT COSTS - STEEL INDUSTRY WAGE EMPLOYEES UNITED STATES, WEST GERMANY, AND JAPAN	22
XIV.	RELATIVE OUTPUT PER MAN-HOUR, HOURLY LABOR COSTS, AND UNIT LABOR COSTS IN THE IRON AND STEEL INDUSTRIES OF FOUR COUNTRIES	22
XV.	STEEL INDUSTRY NET PROFITS 1961-1970	24
XVI.	COMPARISON OF STEEL INDUSTRY PROFITABILITY WITH PROFITABILITY OF ALL MANUFACTURING CORPORATIONS	25

INDEX OF EXHIBITS (Continued)

		Following Page
XVII.	LEADING FOREIGN STEEL PRODUCERS NET PROFITS AS A PERCENT OF SALES AND NET WORTH	25
XVIII.	STEEL INDUSTRY RATE OF RETURN ON NET WORTH AND TOTAL INVESTED CAPITAL	25
XIX.	PROFITS, DIVIDENDS, AND CAPITAL EXPENDITURES	26
XX.	STEEL INDUSTRY NET INTERNAL CASH FLOWS	27
XXI.	STEEL INDUSTRY LONG-TERM DEBT, INTEREST AND DEBT, AND DEBT AS A PERCENTAGE OF NET WORTH AND TOTAL CAPITAL	27
XXII.	PERCENTAGE CHANGES IN PRICES OF SELECTED COMMODITIES AND SERVICES PURCHASED BY STEEL COMPANIES	29
XXIII.	STEEL MANUFACTURING FLOW CHART	33
XXIV.	SINTERING PROCESS FLOW AND ASSOCIATED WASTES	33
XXV.	COKING PROCESS FLOW AND ASSOCIATED WASTES	34

INDEX OF EXHIBITS (Continued)

		Following Page
XXVI.	STEELMAKING PROCESS FLOW AND ASSOCIATED WASTES	34
XXVII.	STEEL FINISHING PROCESS FLOW AND ASSOCIATED WASTES	36
XXVIII.	EFFICIENCIES OF VARIOUS WATER POLLUTION ABATEMENT PROCEDURES	40
XXIX.	RELATIVE USAGES OF WATER POLLUTION ABATEMENT TECHNIQUES	40
XXX.	COST IMPACT AND TECHNOLOGY FOR PROCESSES REQUIRING AIR POLLUTION ABATEMENT	41

I. INTRODUCTION

This volume is Part II of our final report on the potential economic impact of the costs of meeting Federal air and water pollution abatement requirements on the steel industry. Our report is contained in three separately-bound volumes as follows:

- Part I--Executive Summary
- Part II--The Structure of the Steel Industry
- Part III--The Economic Impact of Pollution Abatement

The purpose of this volume is threefold:

- To evaluate the steel industry's growth patterns, operating practices, and competitive environment
- To assess recent steel industry's financial performance
- To describe the process of making steel and identify significant pollutants generated at each production stage along with abatement techniques to control them.

Part II of our report is structured in the following manner:

- Chapters II-V are an economic analysis of steel industry growth patterns, competitive environment, and operating practices. Specific subjects covered are as follows:
  - Steel industry growth
  - Industry structure
  - Markets and prices
  - Foreign trade and competition

10

- Chapter VI assesses recent steel industry financial performance.

- Chapter VII describes the process of making steel and identifies significant pollutants generated at each production stage along with abatement techniques to control them.

II. GROWTH OF THE STEEL INDUSTRY SINCE WORLD WAR II

Despite many difficulties in recent years, iron and steel remains one of the primary industries in the United States by most significant measures:

- Steel is the most widely used single industrial material, especially for the manufacture of transport equipment, construction, producers' and consumers' durables, defense hardware, and metal containers.
- Gross sales in 1970 were close to $20 billion, and annual investment in the past five years has averaged over $2 billion.
- Value added by the basic iron and steel industry in 1967 was $9.6 billion or about 1.2% of the Gross National Product.
- Direct employment during the period 1966-70 averaged over 550,000 persons.
- With 132 million tons of raw steel produced in 1970, the U. S. industry remains the world's largest producer, accounting for 28% of Free World and 20% of total world output.

Since 1965, however, the domestic steel industry has been beset by severe economic problems:

- Output has failed to expand.
- Labor productivity has been stagnant.
- Import market penetration has risen sharply, most recently in specialty steels.
- Profitability and cash flow have declined seriously.

1. STEEL CONSUMPTION IN THE UNITED STATES HAS SIGNIFICANTLY LAGGED GROWTH IN INDUSTRIAL PRODUCTION SINCE THE END OF WORLD WAR II

Exhibit I, following this page, compares steel industry production growth with growth in overall industrial production and in durable goods manufacturing. Between 1947 and its peak in 1966, the FRB index of production for the iron and steel industry rose 49%. Over the same period, the overall industrial production index as well as that for man facturing rose nearly 140%, while the index for durable manufacturing activity increased by 156%. Between 1966 and 1970, the iron and steel index moved erratically, reaching a peak in 1969, but then dropping sharply in 1970 to a level of 2% under 1969. Overall industrial production, in contrast, was higher in 1970 than in 1966. Apparent per-capita consumption of steel has shown little consistent trend for the past two decades. In 1950-54, it averaged 905 pounds annually; in 1960-64, 806 pounds; at its peak in 1965-66, slightly over 1,000 pounds; and in 1970, about 950 pounds.

(1) The Absence of Dynamic Steel Industry Growth Reflects Changes in the Technological Structure of the American Economy

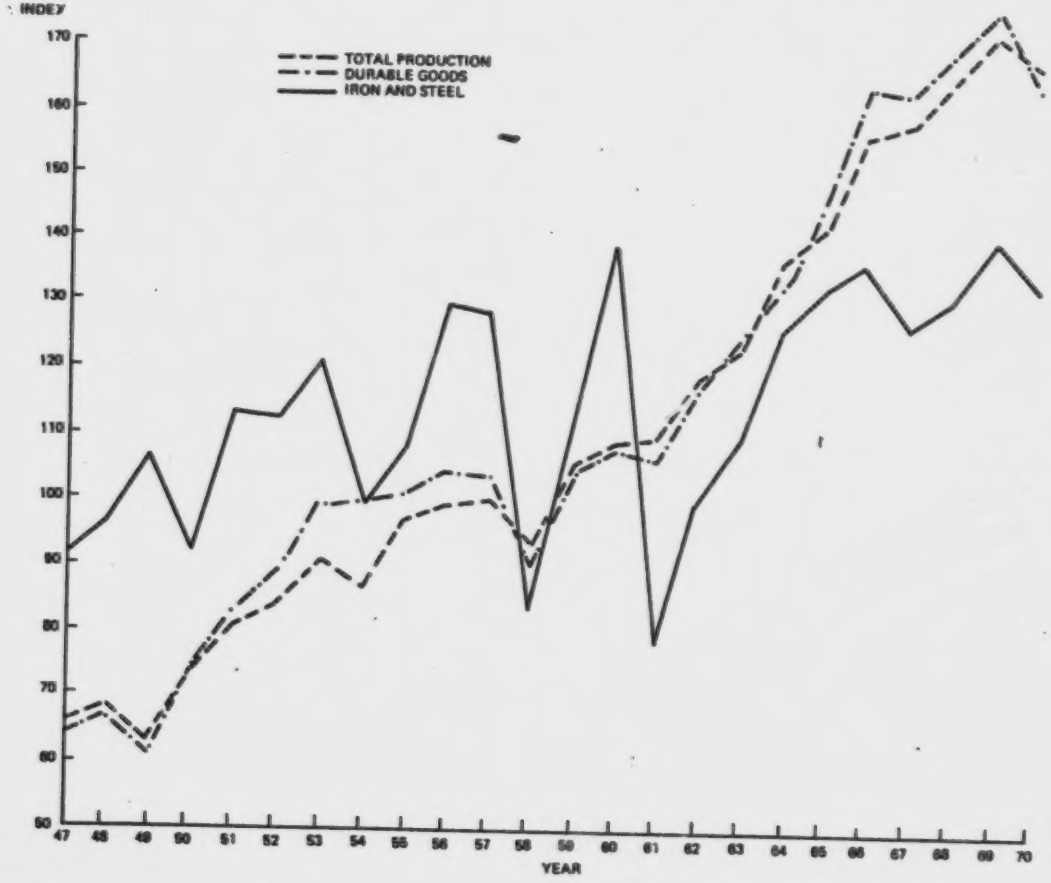
Vigorously growing new industries, such as electronics, require relatively little steel; this is true also of some of the older growth industries such as chemicals. Materials substitution, notably aluminum and plastics, has been extensive. A 1969 study conducted by First National City Bank estimates that the steel industry experienced an annual 1% market loss to substitute materials during the 1960's. Interviews with industry analysts indicate that materials substitution could become especially significant as a growth retardant in specialty steels.

In addition, technological advance has permitted significant economies in steel utilization as in thinner sheet for containers, and lighter structural shapes. The trend toward smaller automobiles has more recently affected industry growth.

EXHIBIT I

Council on Environmental Quality

INDEX OF INDUSTRIAL PRODUCTION
TOTAL PRODUCTION, DURABLE GOODS, AND
IRON AND STEEL
(1957-59 = 100)



SOURCE: FEDERAL RESERVE BOARD

(2) Rapid Price Advances in the 1950's Accelerated the Decline in Steel Demand

Between 1951 and 1957 alone, the BLS index of finished steel prices rose 39%, or an average of 5.6% per annum. (See Exhibit II, following this page.) During the same six years, the average price of all industrial commodities increased just over 8%, or about 1% per year. While steel prices remained essentially stable during the first half of the sixties, the impetus toward substitution and economy resulting from these earlier increases could not easily be dissipated.

2. THE STEEL INDUSTRY GREW IN THE EARLY SIXTIES AND STAGNATED IN THE LATTER SIXTIES

Despite lagging long-term growth, the domestic steel industry enjoyed a period of steady growth from 1961 to 1965 as the general economy expanded, with finished steel shipments of companies reporting to the American Iron and Steel Institute (AISI) rising from 66 million tons in the former to 93 million tons in the latter year, a new record by a substantial margin. (See Exhibit III, following Exhibit II.) This was paralleled by a substantial improvement in profits and profit ratios, stable prices, some increase in employment, and a sharp advance in labor productivity, averaging better than 4% per annum over the 5-year period.

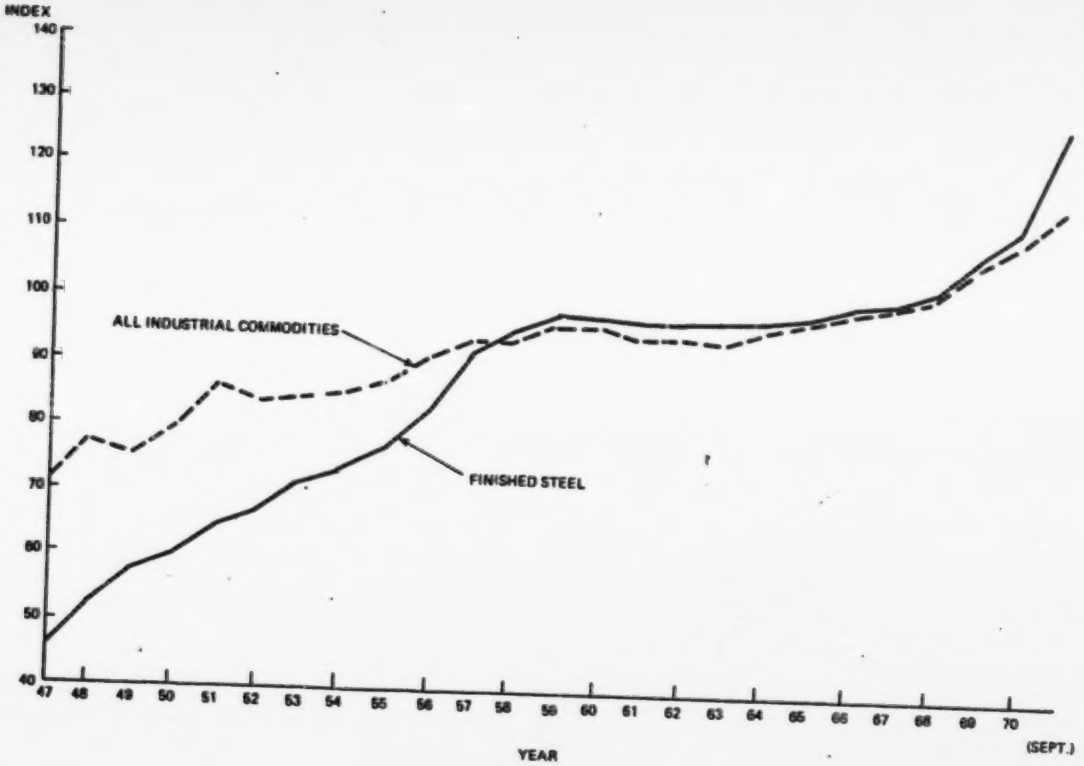
Since 1965-66, the record has been poor. Shipments by reporting companies in 1970 were about 91 million tons, or about 2% under the 1965 peak. Employment declined from 584,000 in 1965 to 531,000 in 1970. (See Exhibit IV, following Exhibit III.) Labor productivity showed virtually no net change between those two years. Profit ratios dropped to the lowest levels since the Great Depression, despite a 17% rise in prices.

For 1971, the picture is even worse. A high level of activity in the first half of the year, reflecting strike-anticipation stockpiling, has been followed by a deep slump in the second half. Total net shipments may be as low as 88 million tons with correspondingly low industry-wide profits for the year.

EXHIBIT II

Council on Environmental Quality

PRICES OF FINISHED STEEL PRODUCTS AND
ALL INDUSTRIAL COMMODITIES
(INDEX: 1967 = 100)



SOURCE: BUREAU OF LABOR STATISTICS

EXHIBIT III

Council on Environmental Quality

NET SHIPMENTS BY PRODUCT GROUP
1961-1970[1]
(Millions of Net Tons)

	YEAR						
	1961	1965	1966	1967	1968	1969	1970
Total Steel Products							
Carbon	61.5	84.1	81.1	76.0	83.2	85.1	83.1
Stainless and Heat Resisting	0.6	0.9	0.9	0.8	0.8	0.9	0.7
Other Alloy	4.1	7.7	8.0	7.0	7.8	7.9	6.9
Total	66.2	92.7	90.0	83.8	91.8	93.9	90.7
Product Groups							
Semi-Finished	2.5	4.5	3.8	4.1	4.8	6.4	7.4
Structural Shapes, Piling, Plates	10.7	16.6	15.9	14.1	14.6	14.5	14.1
Rails and Other Railroad Products	0.8	1.5	1.8	1.4	1.5	1.5	1.6
Bars	10.0	14.4	14.4	12.9	13.6	14.2	14.5
Tool Steel	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Pipe and Tubing	7.1	8.7	9.2	9.0	10.1	9.2	7.8
Wire	3.0	3.5	3.5	3.1	3.4	3.3	3.0
Back and Tin Plate T. F. Steel and Other Tin Mill Products	6.1	6.7	5.8	6.6	7.3	6.6	7.2
Sheets: Hot Rolled	7.0	10.6	10.1	9.3	10.8	12.5	12.3
Cold Rolled	12.2	16.6	16.0	14.7	16.3	16.4	14.3
Strip: Hot Rolled	1.2	1.8	1.6	1.4	1.5	1.5	1.3
Cold Rolled	1.3	1.6	1.6	1.4	1.5	1.4	1.2
Sheets and Strip Galvanized and Coated	4.1	6.2	6.2	5.8	6.5	6.4	6.1
Total[2]	66.2	92.7	90.0	83.8	91.8	93.9	90.7

Source: American Iron and Steel Institute

(1) Beginning with the year 1970 shipment statistics compiled by American Iron and Steel Institute include estimates for a relatively small number of companies which report raw steel production but not shipments to the Institute. The companies shipped an estimated 1.8 million net tons of steel mill products in 1969 and 1970.

(2) Totals may not add due to rounding.

EXHIBIT IV

Council on Environmental Quality

GROWTH OF THE STEEL INDUSTRY SINCE 1953

	YEAR							
	1953	1961	1965	1966	1967	1968	1969	1970
Production (thousands of tons)								
Pig Iron and Ferroalloys	75,857	65,295	88,859	92,150	87,647	89,333	95,480	91,816
Raw Steel (000)	N/A	98,014	131,462	134,101	127,213	131,462	141,262	131,514
Net Shipments (thousands of tons)								
Carbon Steel	N/A	61,470	84,118	81,089	76,042	83,221	85,106	83,185
Alloy	N/A	565	879	933	837	819	910	709
Stainless	N/A	4,091	7,669	7,973	7,018	7,816	7,861	6,944
Total Net Shipments	N/A	66,126	92,666	89,995	83,897	91,856	93,877	90,798[1]
Revenues of Reporting Companies (millions of $)[2]	N/A	$13,295	$ 17,972	$ 18,288	$ 16,880	$ 18,680	$ 19,231	$ 19,117
Net Income--Reporting Companies (millions of $)[2]	N/A	$ 690	$ 1,069	$ 1,075	$ 830	$ 992	$ 879	$ 513
Average Employment (thousands)[3]								
Wage Earners	544	406	459	447	424	421	415	403
Salaried Employees	106	117	125	129	131	131	129	128
Total Average Employment	650	523	584	576	555	552	544	531
Wages and Salaries (millions of $)[4]								
Wages	$ 2,538	$ 2,714	$ 3,549	$ 3,572	$ 3,331	$ 3,571	$ 3,813	$ 3,680
Salaries	677	1,083	1,248	1,323	1,355	1,443	1,518	1,554
Total Wages and Salaries	$ 3,215	$ 3,797	$ 4,797	$ 4,895	$ 4,686	$ 5,014	$ 5,331	$ 5,234
Exports and Imports (thousands of tons)								
Exports	N/A	1,990	2,496	1,724	1,685	2,170	5,229	7,053
(Imports)	(N/A)	(3,163)	(10,383)	(10,753)	(11,455)	(17,960)	(14,034)	(13,364)
Net Export (Import) Balance	(N/A)	(1,146)	(7,887)	(9,029)	(9,770)	(15,790)	(8,802)	(6,311)

Source: American Iron and Steel Institute

[1] 1970 statistics include estimates for a few companies which report production but not shipments. Amount of estimated shipments is 1.8 million tons.

[2] Reporting companies represent approximately 95% of industry production.

[3] Includes only those employees engaged in the production and sale of steel products.

[4] Excludes FICA, unemployment, disability, and other benefits.

3. A COMBINATION OF FACTORS HAS CONTRIBUTED TO THE POOR RECENT INDUSTRY PERFORMANCE

A lack of vigor in the general economy, import market penetration, static productivity, and increasing production costs combined to depress industry performance from the mid-1960's to the present.

(1) The Economic Downturn Which Started in 1969 Has Caused Decreases in Steel Consumption

Steel consumption, including net imports, is estimated at 97.1 million tons for 1970, compared with 100.6 million tons in 1965. Shipments to the automotive industry declined from 20.1 million tons to 14.5 million tons during this period, reflecting both lower auto production and the trend toward smaller cars. Other key consuming sectors, including construction, railroad equipment, and machinery, were also weak. The drop in shipments would have been even greater had it not been for a surge in exports during 1969 and 1970, as world demand temporarily rose faster than world capacity. (See Exhibit IV, following page 5.) This export surge, however, is now over.

(2) Imports Took an Increasing Share of the Domestic Market

In 1970, despite voluntary restraint arrangements entered into by Japanese and Common Market producers, imports accounted for an estimated 13.8% of apparent steel consumption, compared to 10.5% in 1965. For 1971, imports could exceed 15% of apparent consumption.

(3) Lagging Productivity and High Costs Significantly Affected Profitability

Static labor productivity was, in part, a normal reflection of flat demand. In addition, longer than expected break-in periods at many of the newer production facilities resulted in operations at less than

satisfactory efficiency. Coupled with lagging productivity, the following factors contributed significantly to depressed industry profits:

- Low capacity utilization in the face of record level capital expenditures and interest charges
- Sharply rising wages in the face of static productivity
- Substantial advances in materials costs, especially for coal, nickel, and tin
- More than normal shading of prices below posted levels

III. STRUCTURE OF THE DOMESTIC INDUSTRY

1. MOST DOMESTIC STEEL PRODUCTION IS CONCENTRATED IN A FEW LARGE COMPANIES

The U.S. Steel Corporation alone accounts for about one-quarter of raw steel output. The 4 largest companies, U.S. Steel, Bethlehem, Republic, and Armco, account for 54% of raw steel produced, and the 8 largest companies about 75%.

Exhibit V, following this page, shows the concentration of major steel product shipments in 1967. Shipments of semi-finished steel show the highest level of concentration with 67% accounted for by the 4 largest firms and 83% by the 8 largest firms. As can be seen, however, concentration levels are high in all product categories.

In addition to a high degree of concentration among producers, there has been a marked trend toward increased size of the major mills. During the 1950's, large tonnage mills were usually in the one- to two-million ton range, currently they run to five million tons or more.

EXHIBIT V

Council on Environmental Quality

CONCENTRATION OF MAJOR PRODUCT SHIPMENTS

Product	SIC Code	Shipments by Source - 1967			
		4 Largest Producers (%)	8 Largest Producers (%)	20 Largest Producers (%)	50 Largest Producers (%)
Ingots and semi-finished shapes	33122	67	83	96	100
Hot rolled sheet and strip including tin mill products	33123	56	75	99	100
Hot rolled bars, shapes, plates, and piling	33124	62	74	88	99
Steel wire made in steel mills	33125	46	70	98	100
Steel wire not made in steel mills	33155	38	53	81	99
Steel pipes and tubes made in steel mills	33126	55	82	94	100
Steel pipe and tube not made in steel mills	33176	24	38	67	89
Cold rolled sheet and strip made in steel mills	33127	42	69	99	100
Cold rolled sheet,and strip not made in steel mills	33167	41	57	85	100
Cold finished bars and shapes made in steel mills	33128	61	81	100	--
Cold finished bars and shapes not made in steel mills	33168	64	78	97	100

Source: U. S. Department of Commerce (Census of Manufacturers - 1967)

2. GEOGRAPHIC CONCENTRATION OF STEEL PRODUCTION IS SIGNIFICANT

As indicated by Table I, below, steel production tends to be geographically concentrated:

Table I

Raw Steel Production by States and Regions - 1970

State/Region	Million Tons	Percent	Cumulative Percent
Indiana/Illinois	30.2	23.0	23.0
Pennsylvania	30.0	22.8	45.8
Ohio	21.7	16.5	62.3
Michigan	9.5	7.2	69.5
Other Northeast	14.1	10.7	80.2
Southeast	12.0	9.1	89.3
West (Incl. California)	8.7	6.6	95.9
Southwest	5.3	4.1	100.0
Total	131.5	100.0	

Five states in the Northeast and Midwest account for almost 70% of raw steel output. If production in the balance of the Northeast is added, more than 80% of production is accounted for.

Exhibit VI, following this page, shows the changes which have taken place from 1953 to 1970 in the share of raw steel produced by state and region. While raw steel production remains concentrated in the Northeast and Midwest, the Southeast, West, and Southwest have made noticeable gains, increasing from a total production share of 17.2% to 19.8%. Significant slippage in percent of total raw steel produced occurred in Pennsylvania and Ohio, partially offset by gains in Michigan. Changes in the pattern of output reflect the movement of production toward growing regional markets. Since major markets remain concentrated in the Midwest (Chicago-Detroit) and the Northeast, however, it is expected that steel production will remain heavily concentrated in these regions.

EXHIBIT VI

Council on Environmental Quality

RAW STEEL PRODUCTION BY STATE AND REGION
1953, 1961, 1970

State/Region	1953 Tons	1953 %	1961 Tons	1961 %	1970 Tons	1970 %	Change (%) 1953-1970
Indiana/Illinois	23.0	20.6	22.4	23.2	30.2	23.0	-0-
Pennsylvania	31.1	27.9	22.4	23.2	30.0	22.8	(18.3)
Ohio	21.7	19.4	16.5	17.1	21.7	16.5	(14.9)
Michigan	6.0	5.3	6.7	6.9	9.5	7.2	20.0
Other Northeast	12.6	11.3	11.8	12.2	14.1	10.7	(5.3)
Southeast	8.7	7.8	7.0	7.2	12.0	9.1	16.7
West (including California)	5.1	4.6	6.7	6.9	8.7	6.6	29.4
Southwest	3.4	3.0	3.1	3.2	5.3	4.1	20.6
Total	111.6	100.0*	96.6	100.0*	131.5	100.0*	

*May not add due to rounding.

Source: American Iron and Steel Institute.

There is some reason to believe that opportunities for further growth of steelmaking on the West Coast will be limited. Bethlehem Steel Corporation recently announced the sale of land in Richmond, California, which had been intended for a steel plant. The reason cited for abandoning the proposed plant was intense West Coast market pressure from Japanese imports. An additional factor which may have contributed to this decision is the nature of West Coast manufacturing industries which tend more toward assembly than metal fabrication.

3. STEELMAKING "MINIMILLS" HAVE DEVELOPED RECENTLY, BUT SHOULD NOT MATERIALLY AFFECT INDUSTRY CONCENTRATION LEVELS

In recent years, a number of "Minimills" has been established specializing in the production of a limited product line to serve local area markets. Products are mainly hot-rolled bars, concrete reinforcing rods, bar size structural shapes, and wire rods.

Plants are typically scrap-melting electric furnace installations with an average annual capacity of 177,000 tons. As of 1970, there were 37 such minimills with a total capacity of 5.3 million tons.

Minimills are generally located near ample scrap supplies. The following economic advantages allow them to compete with larger producers.

- Product lines are limited, allowing efficient capacity utilization with limited downtime for changeovers.
- Market radius is limited, providing freight cost and customer service advantages.

On the other side of the coin, minimills are vulnerable to the rising cost of electric power and fluctuations in the price of scrap.

The small size of the minimills and their limited product lines make it unlikely that they will have any substantial impact on industry structure in the forseeable future.

4. A HIGH DEGREE OF INTEGRATION IS TYPICAL OF THE LARGER STEEL PRODUCERS

Of the total of about 200-steel producing companies, 25 are integrated from the blast furnace through the rolling mill, 61 produce raw steel from scrap only, and the remainder purchase semi-finished steel for rolling into finished products.

Backward integration beyond the blast furnace is typical of the larger companies. They normally own, lease, or otherwise control their principal raw material supplies which include: iron ore, coal, limestone, and, in some cases, manganese, both in the United States and abroad. U.S. Steel and Bethlehem own or control lake transportation facilities and feeder railroads. U.S. Steel generates about half of its electric power requirements.

Forward integration is less pronounced and varies in character. U.S. Steel produces cement, heavy steel containers, prefabricated homes, plastic materials, and engages in heavy construction activities. It also owns steel distribution centers. Bethlehem has a shipbuilding unit. Republic produces steel office equipment, drums and barrels, and other fabricated products. Armco provides rotary drilling equipment and underground pumps for the oil industry. For the smaller companies, the degree of integration tends to lessen progressively, and is virtually nil for the minimills.

5. THE STEEL INDUSTRY IS BEGINNING TO DIVERSIFY INTO OTHER INDUSTRIES

Diversification into operations not directly related to iron and steel has been virtually absent in the past, but moves in this direction are commencing.

Armco Steel, which derives more than 20% of its revenue from non-steelmaking activities, is the most diversified major producer. Non-steel related operations include non-metallic materials, leasing, and insurance. U.S. Steel has moved into the fiberglass and real estate development industries. National Steel has acquired an aluminum division.

Industry analysts contacted expect this diversification trend to continue. However, because of the mammoth size of the steel industry, it is not expected that non-steelmaking activities will have a significant impact on revenues and earnings in the near term.

With one major exception--the recent takeover of Jones and Laughlin by Ling-Temco-Vought--the industry has essentially bypassed or been bypassed by the conglomerate movement. Over the longer term, however, steelmakers may begin to move rather far down the conglomerate road, financial resources and antitrust policies permitting.

IV. MARKETS AND PRICES

1. THE MARKET FOR STEEL IS SUBJECT TO CYCLICAL INFLUENCES

Recessions in the general economy such as those of 1961, 1967, and 1970 are normally reflected in substantial reductions in steel sales and shipments.

(1) The Steel Industry Is Particularly Vulnerable To Fluctuations in Automotive Production

The automotive industry is the single largest customer of the steel industry. During the period 1961-69, it accounted for an average of 21% of total tonnage of direct shipments by the domestic steel industry, without taking into account indirect shipments to machinery manufacturers and others which were ultimately destined to support automotive production. (See Exhibit VII, following this page.)

In 1970, the ratio of automotive industry shipments dropped sharply to 15.9%, reflecting the slump in domestic automobile production during that recession year to 6.5 million passenger cars compared to 8.2 million in 1969. Steel shipments to the automotive industry declined from 18.3 million tons in 1969 to 14.5 million tons in 1970, or over 20%, underlining the sensitivity of the steel industry to such cyclical influences.

In addition to cyclical influences, there has been a marked secular trend toward the use of less steel per car. Table II, following this page, illustrates this trend.

EXHIBIT VII

Council on Environmental Quality

STEEL SHIPMENTS BY MAJOR MARKET
(Thousands of Net Tons)

Market Classification	YEAR 1961		1965		1966		1967		1968		1969		1970 (1)	
	Tons	%	Tons	%	Tons	%	Tons	%	Tons	%	Tons	%	Tons	%
Steel for Converting & Processing, Forgings, Bolts, etc.	4,133	6.3	6,416	6.9	5,796	6.5	5,173	6.1	5,222	5.7	5,583	5.9	5,496	6.1
Steel Service Centers	12,365	18.7	16,369	17.7	16,400	18.2	14,863	17.7	16,099	17.5	17,565	18.7	17,678	19.5
Construction & Contractors	13,111	19.8	16,854	18.2	16,831	18.7	15,957	19.1	17,117	18.7	16,170	17.2	15,005	16.5
Automotive	12,594	19.1	20,123	21.7	17,984	20.0	16,488	19.7	19,269	21.0	18,276	19.5	14,475	15.9
Rail	1,594	2.4	3,805	4.1	4,332	4.8	3,225	3.8	3,048	3.3	3,344	3.6	3,098	3.5
Shipbuilding & Marine	680	1.0	1,051	1.1	1,017	1.1	943	1.1	1,006	1.1	907	1.0	859	0.9
Aircraft, Oil & Gas Drilling, Mining, Quarrying, Lumbering	725	1.1	866	0.9	989	0.9	762	0.9	934	1.0	878	1.0	798	0.9
Agricultural	1,050	1.6	1,483	1.6	1,705	1.9	1,409	1.7	1,400	1.5	1,177	1.2	1,126	1.2
Machinery & Equipment	5,728	8.7	8,858	9.5	8,768	9.8	7,802	9.3	8,366	9.2	8,503	9.1	7,863	8.5
Domestic & Commercial Appliances & Equipment	3,560	5.3	4,358	4.8	4,526	5.1	4,152	5.0	4,362	4.7	4,186	4.4	3,938	4.4
Containers	6,623	10.0	7,331	7.9	6,597	7.3	7,255	8.6	7,902	8.6	7,145	7.6	7,775	8.5
Military	182	0.3	289	0.3	686	0.8	1,622	1.9	2,025	2.2	1,758	1.9	1,222	1.3
Export	1,730	2.6	2,078	2.3	1,541	1.7	1,407	1.7	2,147	2.3	5,004	5.3	5,985	6.6
All Other	2,051	3.1	2,785	3.0	2,914	3.2	2,839	3.4	2,959	3.2	3,391	3.6	5,480	6.1
Total	66,126	100.0	92,666	100.0	89,995	100.0	83,897	100.0	91,856	100.0	93,877	100.0	90,798	100.0

Source: American Iron & Steel Institute

(1) Beginning with the year 1970, shipment statistics compiled by American Iron and Steel Institute include estimates for a relatively small number of companies which report raw steel production but not shipments to the Institute. The companies shipped an estimated 1.8 million net tons of steel mill products in 1969 and 1970.

Table II

Use of Steel in Automobile Manufacturing
(Pounds)

Year	Steel
1959	4,220
1964	3,960
1970	3,600

Source: Smith Barney, Inc.

Average steel consumption per car decreased by about 15% from 1959 to 1970. This was due primarily to the following causes:

- Consumer preferences for smaller cars
- The use of stronger and lighter steel in frames and bodies
- Substitution of aluminum and plastics

(2) Cyclical Movements in the Construction Industry Also Have Major Effects on the Steel Industry

The second most important steel industry customer is the construction industry. Between 1961 and 1968, direct shipments to the construction industry ranged from 18% to 20% of total shipments. These ratios understate the importance of construction to the steel market, however, since substantial additional tonnage of construction steel moves through steel service centers. Direct shipments to the construction industry dropped to 17.2% in 1970 as construction activity lagged during the recession.

Over the years, steel consumption per unit of construction has tended to decline with the development and increasing use of higher strength steels. Substitution of reinforced concrete for structural shapes has also increased.

(3) Cyclical Movements As Well As Economic and Social Trends Have Affected Other Steel Markets

- Shipments to machinery and equipment industries, also highly cyclical, decreased in both volume and percentage during 1970 as a result of the recession.

- Shipments to the container industry in 1970 were greater than in 1969 and approached the 1968 high of 7.9 million tons. The future of steel containers is clouded, however, due to uncertainty as to solution of the solid waste disposal problem they present.

- In 1970, the volume of steel moving through steel service centers (warehouses) reached a high of 17.7 million tons or 19.5% of total shipments. Data breaking down these shipments by ultimate use are not available.

- Direct shipments for ordnance and other military use, normally less than 1% of total shipments, reached a peak of 2.2% in 1968 as a result of the Vietnam war. By 1970, such shipments had declined to 1.3% as the war decreased in intensity. This decrease in shipments should continue.

(4) The Export Market for Steel May Shrink Further as Other Countries Continue To Expand Production at Lower Than U. S. Costs

With the revival of foreign steel capacity, the U.S. lost the position of a major steel exporter which it had enjoyed during the years following World War II. During most of the sixties, exports rarely exceed 2 million tons annually. A significant proportion of exports, moreover, was on AID contracts, where procurement was limited to goods of U.S. source and origin.

During 1969 and 1970, exports jumped to 5 million and 6 million tons respectively, accounting in the latter year for 6.6% of total shipments. This was, however, recognized as a temporary phenomenon, due to a sudden sharp increase in world demand. Exports for 1971 are expected to be back around the two million ton range. Additionally, a disproportionately large share of these exports (45% in

1970) was low unit-value semi-finished steel for finishing abroad. Had it not been for this temporary increase in exports, the downtrend in industry shipments between 1965 and 1970 would have been even more pronounced.

2. UNTIL RECENTLY, STEEL PRICES HAVE BEEN RIGID AND GENERALLY UNRESPONSIVE TO CHANGES IN DEMAND

Steel prices have risen sharply and steadily since the end of World War II, with some effect on the growth of demand and the balance of trade in steel. Changes in published price quotations have reflected significant price leadership, generally exercised by U. S. Steel until the mid 1960's, although other companies have initiated price changes in recent years with increasing frequency. While hard evidence is lacking, there are indications, strengthened by our contacts with industry sources, that import competition and slack demand have made negotiated prices below published levels more common than in the past, especially on large orders.

(1) Except for the Period 1961-1965, Quoted Steel Prices Have Advanced Steadily Since World War II

Exhibit VIII, following this page, compares the behavior of steel shipments and finished steel prices. Despite fluctuations in shipments, steel prices have trended steadily upward since the end of World War II, except for the period 1960-1965. Between 1947 and 1960, the BLS index of finished steel prices rose 108%, or at an annual average rate of 5.9%. Over the same period, the average price of all industrial commodities rose only 35%. (See Exhibit II, following page 5.

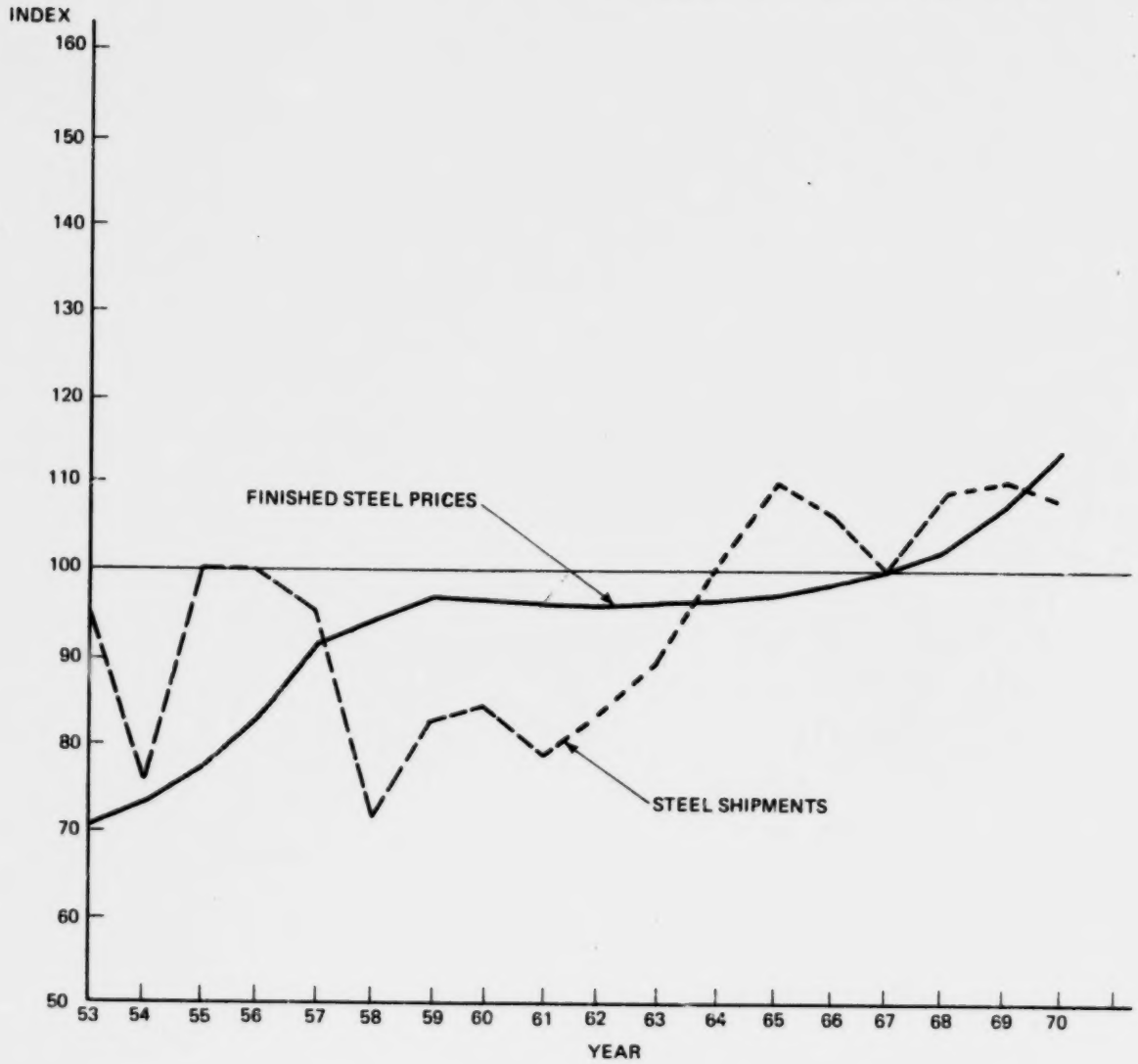
For the next five years, finished steel prices showed little net change, rising only 1.2% between 1960 and 1965. This was due in part to pressure by the Administration, including notably the Kennedy-Blough confrontation in 1962.

After 1965, despite continuing urging of restraint by the Administration, prices resumed their advance, accelerating sharply after the abandonment of such efforts by the Nixon Administration when it took office in 1969. Between 1965 and 1970 (annual averages), the BLS index for finished steel rose over 18%, or again significantly faster than industrial prices generally. There were further sharp

EXHIBIT VIII

Council on Environmental Quality

COMPARISON OF FINISHED STEEL PRICES
AND TOTAL SHIPMENTS 1953-1970



(1967 = 100)

SOURCE: DERIVED FROM AMERICAN IRON & STEEL INSTITUTE STATISTICS

increases during 1971, until the imposition of the wage-price freeze in August. The index for September 1971 showed an increase of over 10% in 12 months.

(2) In Recent Years, It Appears That Discounting Below Quoted Prices Has Increased

Exhibit IX, following this page, compares finished steel prices with weighted average sales realization. After 1967, it would appear that discounting became more prevalent in the industry as quoted prices increased at a more rapid pace than sales realization. These developments reflect partly the increasing pressure of low priced imports along with slack demand.

There are also indications that uniformity of policy among major producers has been decreasing. In the fall of 1968, following the conclusion of the labor settlement, U. S. Steel announced increases lower than those previously posted by other producers. Shortly thereafter, Bethlehem announced substantial further cuts for a limited period. The episode soon ended, however, and prices resumed their advance at a rapid pace. Between December 1968 and September 1971, the index of finished steel prices rose 25%.

(3) The Behavior of Steel Prices Appears To Reflect the Industry View That Steel Demand Is Inelastic To Price

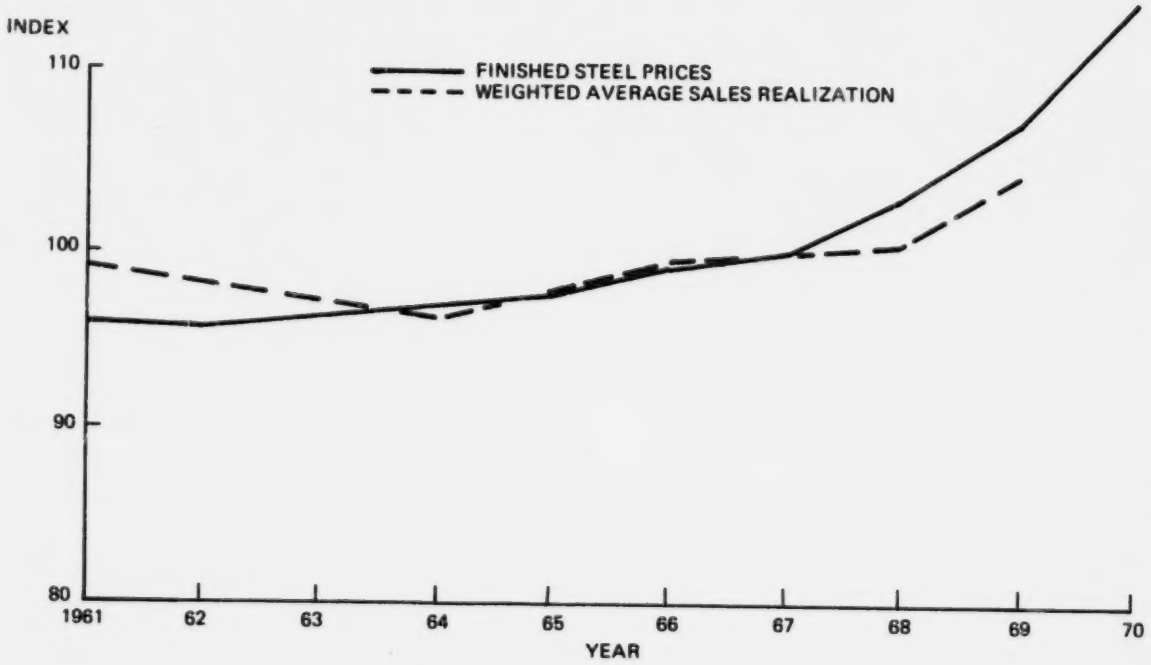
Aside from price shading, the steel industry has demonstrated reluctance to adjust prices to meet changing levels of demand, and especially to reduce prices to stimulate demand during weak markets. This appears to reflect the implicit assumption that demand is inelastic to price. This assumption is undoubtedly related to the fact that the market for steel as such is removed by one or more stages from final demand for end products containing steel, for which the cost of steel is generally not a major factor. Nevertheless, some elasticity undoubtedly does exist. A study by the Department of the Interior in 1970* estimated this elasticity at -0.85; that is, a 1%

*U.S. Department of the Interior, Bureau of Mines, A Quantitative Economic Analysis and Long-Range Projections of the Demand for Steel Mill Products, 1970.

EXHIBIT IX

Council on Environmental Quality

PRICES AND SALES REALIZATION
FINISHED STEEL
(INDEX: 1967 = 100)



SOURCE: AMERICAN IRON & STEEL INSTITUTE

increase in steel prices would result in a 0.85% reduction in steel demand, all other things being equal. While any such mathematical calculations are subject to many uncertainties, a relationship between price and demand does exist, and the steady increase in steel prices since World War II has had some dampening impact on the growth of steel markets. Moreover, rising prices for domestic steel have been a factor in stimulating imports and retarding exports.

V. FOREIGN TRADE AND COMPETITION

1. STEEL IMPORTS, MAINLY FROM JAPAN AND THE EUROPEAN COMMUNITY, HAVE GROWN VERY RAPIDLY SINCE 1959

The rapid increase in steel imports has absorbed a substantial share of the growth of domestic markets. Exports, on the other hand, except for a brief spurt in 1969-1970, have fallen sharply compared with earlier postwar years.

(1) The Peak in Steel Imports Was Reached in 1968 at 18 Million Tons or 16.7% of the Domestic Market

Exhibit X, following this page, compares domestic steel shipments with steel imports and exports. Until 1959, imports were small, and substantially exceeded by exports. The prolonged strike during that year led to the first spurt in imports, which rose to 4.4 million tons as compared with only 1.2 million tons in 1957. After 1959, imports grew rapidly in a series of spurts reflecting precautionary stockpiling coinciding with the scheduled expiration of labor contracts, and largely retained these gains after each labor settlement had been reached. The peak was reached in 1968, when 18 million tons were imported, representing 16.7% of the apparent domestic market.

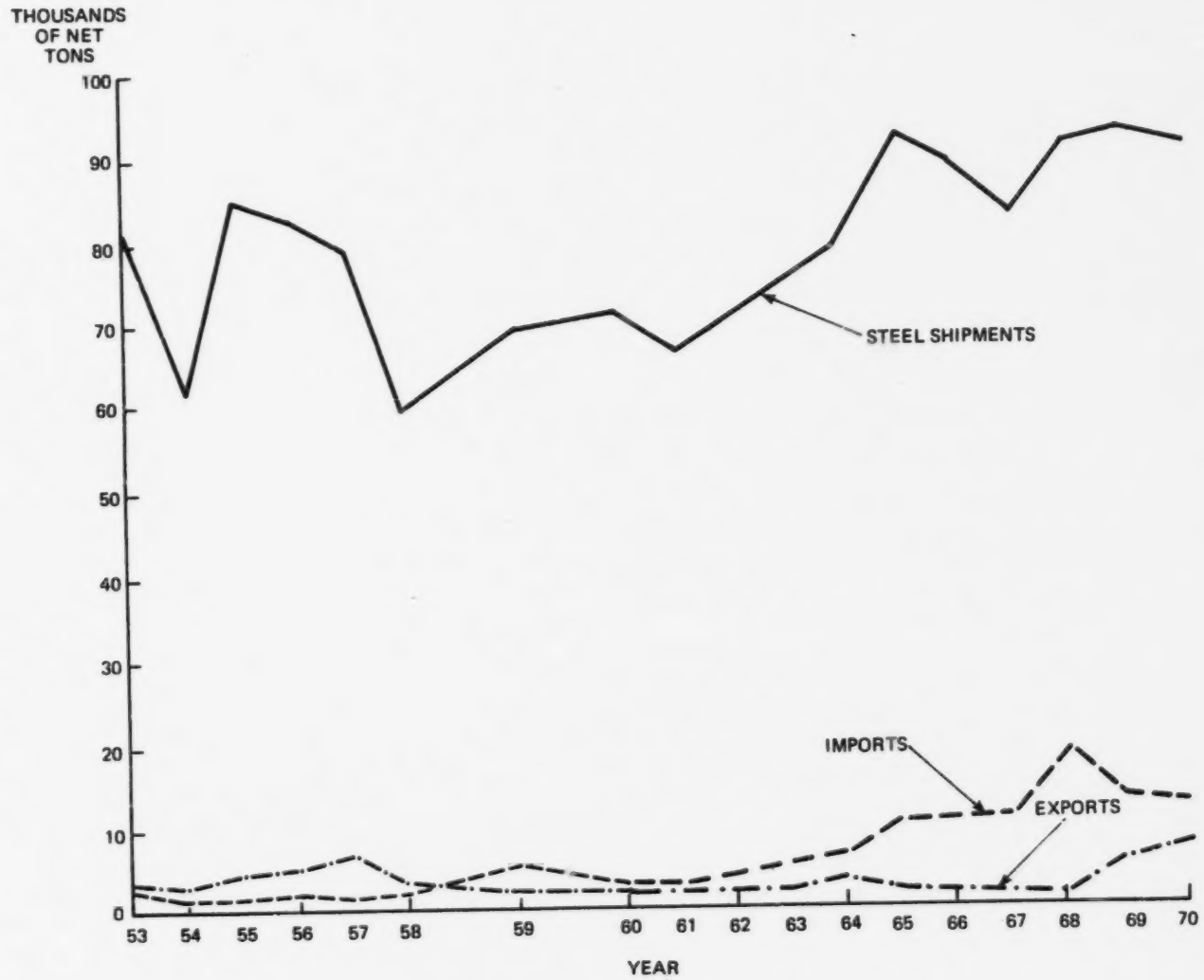
(2) Steel Exports Have Decreased as Imports Increased

Exports dropped from 5.3 million tons in 1957 to 1.7 million tons in 1959. Throughout the 1960's, exports continued at a low level except for a brief spurt in 1969-1970 as world demand for steel temporarily exceeded capacity. A significant portion of the tonnage exported during the shortage period was in low value semifinished shapes for further processing overseas. This factor limited the contribution to industry profits made by exports during this period. As of the present, world capacity has risen while world demand has

EXHIBIT X

Council on Environmental Quality

COMPARISON OF TOTAL U. S. SHIPMENTS
IMPORTS AND EXPORTS 1953-1970



dropped. It is unlikely that the U. S. industry can anticipate that export markets for steel would rise above their present low levels of around 2 million tons, and they may decrease.

(3) Market Penetration by Imports Led To Voluntary Restraint Arrangements in 1969

Seeking to avoid the imposition of mandatory import restrictions, the Japanese and European Economic Community (EEC) industries entered into Voluntary Restraint Arrangements (VRA) with the State Department, each group undertaking to hold its respective exports to 5.75 million tons for 1969, to increase by 5% each in 1970 and 1971. It was estimated that imports from other sources would be about 2.5 million tons in 1969 for a total of 14 million tons. It should be emphasized that these were not government-to-government agreements.

Imports in 1969 reached just about the estimated level of 14 million tons, or 4 million tons under the 1968 peak. In 1970 they actually dropped to 13.4 million tons, well under the 14.7 million tons anticipated in the VRA, taking into account the 5% annual improvement factor. This shortfall reflected the fact previously mentioned, that world demand temporarily outran the growth of world capacity, especially in Europe. Actually, imports from Japan at 6.3 million tons somewhat exceeded their agreed level which would have been about 6 million tons, but EEC exports fell considerably short at 4.8 million tons. During 1971, imports have again risen sharply as the temporary squeeze on world supplies eased. They totaled about 12 million tons in the first 8 months of this year, and the rate will have to be much slower in the last 4 months or the VRA quotas will be exceeded by a wide margin.

(4) While Total Import Tonnage Decreased, Change in Product Mix Badly Hurt the Specialty Steel Industry, and Import Pressure on Western Producers Did Not Abate

The VRA provided that the Japanese and ECE producers would use their "best efforts" to maintain the existing product mix and geographic destination of their exports. These "best efforts" appear to have had little effect. In fact, imports of stainless and tool steels have risen not only relatively but absolutely from the 1968 peaks, imposing very severe pressure on domestic producers of these specialty products, which normally command prices about 10 times that of ordinary carbon steel.

In 1970, imports of stainless steel at 177,000 tons equaled 25% of total U.S. shipments and 22% of apparent consumption. In addition, exports to the Pacific states, mainly from Japan, have shown a sharp relative increase, so that the VRA has yielded little benefit to Western producers.

2. THE STEADY INROADS OF IMPORTS INTO THE DOMESTIC MARKET REFLECT THE EROSION OF THE DOMESTIC STEEL INDUSTRY'S COMPETITIVE POSITION IN WORLD MARKETS

Present capacity in Japan is probably as modern as in the United States, and the EEC is not far behind. While labor productivity in the United States is still the highest in the world, the gap is narrowing rapidly, and unit labor costs per ton abroad are much lower than domestically. Imported steel, especially from Japan, enjoys a large price advantage.

(1) European and Japanese Capacity Is, on the Average, Newer Than U.S. Capacity

There is currently no essential difference in technological know-how among major steel producing nations. Not having faced the destruction of World War II, plants in the U. S. are generally older than plants in Japan and Western Europe which had to be largely built after the war. Because their plants are newer, Japanese and European producers have been able to develop a large share of their capacity on the basis of the most modern available technology. In Japan, for instance, most steel plants have been built since 1960.

(2) The Domestic Advantage in Labor Productivity Is Rapidly Disappearing

Labor productivity in the United States remains unequaled, but this advantage is narrowing rapidly. Estimates from different sources vary widely in specifics, but all agree on this basic trend.

Exhibit XI, following this page, shows man-hours per ton of products shipped in the United States dropping from 15.0 in 1960 to 12.0 in 1966 and thereafter remaining static. For West Germany, man-hours per ton are shown declining steadily from 24.3 in 1960 to 14.5 in 1970, and in Japan from 44.2 to 12.4 over the same years.

EXHIBIT XI

Council on Environmental Quality

MAN-HOURS PER TON - STEEL MILL PRODUCTS
FOR THE U.S., WEST GERMANY, AND JAPAN

	United States	West Germany	Japan
1960	15.0	24.3	44.2
1961	14.6	25.1	38.6
1962	13.9	24.5	40.7
1963	13.3	24.9	34.5
1964	12.7	21.6	28.6
1965	12.2	21.6	27.9
1966	12.0	21.1	23.7
1967	12.4	19.2	19.1
1968	12.0	19.5	16.5
1969	11.7	15.5	14.0
1970	11.9	14.5*	12.4*

*Projected on the basis of past experience.

Source: American Iron & Steel Institute
Calculated from Bureau of Labor Statistics data.

There is some question, however, regarding the accuracy of these figures, for example, the estimate of the work force properly assignable to the Japanese steel industry may be understated due to Japanese subcontracting procedures, and productivity correspondingly overstated. Other estimates prepared by the Bureau of Labor Statistics (Exhibit XII, following this page), however, show productivity in the United States rising 7.8% between 1964 and 1969, in Japan by 103%, in West Germany by 38%, and in the United Kingdom by 14%. Thus, while perhaps lacking in some accuracy, estimates clearly indicate the relative lack of productivity growth in the domestic industry.

(3) The Absolute Gap in Hourly Employment Costs Between the U.S., West Germany, and Japan Is Widening

U.S., West Germany, and Japanese hourly steel industry employment costs are compared in Exhibit XIII, following Exhibit XII. While wage rates in Japan and West Germany have been rising more rapidly than in the United States in percentage terms, the absolute difference has actually widened. Thus, between 1960 and 1970 hourly employment costs (including fringes) in the United States are estimated to have risen about 50% while those in Japan trebled and in West Germany more than doubled. Yet, according to these figures, the absolute gap between American and Japanese hourly compensation rose from $3.20 per hour in 1960 to $3.85 in 1970, and between American and German compensation from $2.61 to $3.03. Again, there is some question regarding the validity of these figures, e.g., Japanese fringes may have been underestimated, but the basic trend seems clear.

Taking into account both productivity and employment cost differentials, the Bureau of Labor Statistics estimates that 1969 labor costs per ton of steel in Japan were 28 to 35% of the U.S. level, and in Germany 51 to 63% of the U.S. level. (See Exhibit XIV, following Exhibit XIII.) Whatever the accuracy of these estimates, the differences are clearly substantial, and account in good part for the U.S. competitive disadvantage, as employment costs of major U.S. steel producers averaged 41% of total costs during 1970.

EXHIBIT XII (1)

Council on Environmental Quality

INDEXES OF OUTPUT PER MAN-HOUR, HOURLY COMPENSATION, AND UNIT LABOR COSTS IN THE IRON AND STEEL INDUSTRIES OF FOUR COUNTRIES, AND UNDERLYING DATA, 1964-1970
(1964 = 100)

Country and Year	Output Per Man-Hour	Compensation Per Man-Hour		Unit Labor Cost		Output	Man-Hours	Labor Cost (National Currency)
		National Currency	U.S. Dollars 1/	National Currency	U.S. Dollars 1/			
United States								
1964	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1965	104.0	101.5	101.5	97.6	97.6	108.8	104.6	106.1
1966	106.2	105.3	105.3	99.3	99.3	109.5	103.2	108.7
1967	102.9	108.7	108.7	105.7	105.7	101.8	99.0	107.6
1968	107.2	114.7	114.7	106.9	106.9	107.8	100.6	115.4
1969 2/	107.8	123.4	123.4	114.5	114.5	110.5	102.5	126.4
1970 2/	104.7	126.8	126.8	121.0	121.0	102.2	97.6	123.8
Japan								
1964	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1965	105.0	110.6	110.6	105.3	105.3	102.8	97.8	108.2
1966	123.1	123.1	123.1	100.0	100.0	118.8	96.5	118.8
1967	152.9	139.6	139.6	91.3	91.3	153.8	100.5	140.3
1968	168.9	158.7	158.7	94.0	94.0	173.1	102.4	162.6
1969	203.4	189.8	189.8	93.3	93.3	208.5	102.5	194.6
1970 3/								
United Kingdom								
1964	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1965	104.5	108.8	108.8	104.1	104.1	106.2	101.6	110.6
1966	102.8	119.1	119.1	115.9	115.9	97.9	95.2	113.4
1967	103.1	115.4	113.5	112.0	110.2	92.9	90.1	104.0
1968	110.3	126.2	108.5	114.3	98.3	100.2	90.8	114.5
1969 2/	114.1	137.4	118.1	120.4	103.5	104.7	91.7	126.0
1970 3/								

EXHIBIT XII (2)

Country and Year	Output Per Man-Hour	Compensation Per Man-Hour		Unit Labor Cost		Output	Man-Hours	Labor Cost (National Currency)
		National Currency	U.S. Dollars[1]	National Currency	U.S. Dollars[1]			
West Germany								
1964	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1965	99.7	109.8	109.8	110.0	110.0	99.7	100.0	109.7
1966	103.0	116.2	116.2	112.8	112.8	96.1	93.3	108.4
1967	113.6	119.6	119.6	105.3	105.3	99.5	87.6	104.7
1968	128.1	126.3	126.3	98.6	98.6	113.9	88.9	112.3
1969	140.3	142.0	144.1	101.2	102.7	128.1	91.3	129.6
1970[2]	137.8	163.1	178.3	188.4	129.4	133.4	96.9	158.0

[1] Exchange rates: U.S. $1 = 360 yen; 0.3584 pounds in 1964-1966, 0.3643 pounds in 1967, and 0.4167 pounds in 1968-1969; 4.0 marks in 1964-1968, 3.94 marks in 1969, and 3.66 marks in 1970.
[2] Preliminary.
[3] Not available.
[4] Preliminary estimates based on data for 9 months.

NOTE: Indexes relate to the iron and steel industry as defined in each country.

Prepared by: Bureau of Labor Statistics
Office of Productivity and Technology
Division of Foreign Labor Statistics and Trade
May 11, 1971

EXHIBIT XIII

Council on Environmental Quality

HOURLY EMPLOYMENT COSTS
STEEL INDUSTRY WAGE EMPLOYEES
UNITED STATES, WEST GERMANY, AND JAPAN
(Includes Fringe Benefits)

Year	United States	West Germany	Japan	Difference Between USA and West Germany	Japan
1960	$3.82	$1.21	$0.62	$2.61	$3.20
1961	3.99	1.37	.68	2.62	3.31
1962	4.16	1.51	.74	2.65	3.42
1963	4.25	1.59	.80	2.66	3.45
1964	4.36	1.68	.88	2.68	3.48
1965	4.48	1.81	.97	2.67	3.51
1966	4.63	1.91	1.08	2.72	3.55
1967	4.76	1.98	1.22	2.78	3.54
1968	5.03	2.09	1.34	2.94	3.69
1969	5.38	2.37 1/	1.59 1/	3.01 1/	3.79 1/
1970	5.68	2.65 2/	1.83 2/	3.03 2/	3.85 2/

1/ Preliminary
2/ Estimated

Source: American Iron and Steel Institute
Based on Japanese Ministry of Labor and EEC data.

EXHIBIT XIV (1)

Council on Environmental Quality

RELATIVE OUTPUT PER MAN-HOUR, HOURLY LABOR COSTS, AND UNIT LABOR COSTS IN THE IRON AND STEEL INDUSTRIES OF FOUR COUNTRIES, 1964-1970[1]
(U.S. = 100)

Item and Year	United States	Japan		United Kingdom		West Germany	
		Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Output per man-hour							
1964	100.0	39.6	49.3	46.1	50.1	54.2	63.3
1965	100.0	40.0	49.8	46.3	50.4	51.9	60.7
1966	100.0	45.9	57.2	41.6	48.5	52.5	61.4
1967	100.0	58.8	73.3	46.2	50.2	59.9	69.9
1968	100.0	62.4	77.7	47.4	51.6	64.7	75.7
1969	100.0	74.7[3]	93.0[3]	48.8[2][3]	53.1[2][3]	70.5	82.4
1970	100.0					71.3[4]	83.3[4]
Hourly labor cost (in U.S. dollars at constant 1964 exchange rates)							
1964	100.0	16.8	17.1	28.7	29.6	36.5	38.9
1965	100.0	18.3	18.6	30.7	31.7	39.5	42.1
1966	100.0	19.7	20.0	32.5	33.5	40.3	42.9
1967	100.0	21.6	22.0	30.5	31.5	40.2	42.8
1968	100.0	23.3	23.6	31.6	32.6	40.2	42.8
1969	100.0	25.9[3]	26.3[3]	31.9[2][3]	33.0[2][3]	42.0	44.7
1970	100.0					46.9[4]	50.0[4]
Hourly labor cost (in U.S. dollars at current exchange rates[5])							
1964	100.0	16.8	17.1	28.7	29.6	36.5	38.9
1965	100.0	18.3	18.6	30.7	31.7	39.5	42.1
1966	100.0	19.7	20.0	32.5	33.5	40.3	42.9
1967	100.0	21.6	22.0	30.0	30.9	40.2	42.8
1968	100.0	23.3	23.6	27.1	28.0	40.2	42.8
1969	100.0	25.9[3]	26.3[3]	27.5[2][3]	28.4[2][3]	42.6	45.5
1970	100.0					51.3[4]	54.7[4]

EXHIBIT XIV (2)

Item and Year	United States	Japan		United Kingdom		West Germany	
		Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Unit labor cost (in U.S. dollars at constant 1964 exchange rates)							
1964	100.0	34.1	43.4	57.4	64.1	57.8	71.7
1965	100.0	36.8	46.8	60.3	68.3	65.2	80.8
1966	100.0	34.3	43.7	67.0	74.8	65.7	81.5
1967	100.0	29.4	37.5	60.8	67.9	57.6	71.4
1968	100.0	30.0	38.2	61.4	68.6	53.3	66.1
1969	100.0	27.8	35.4	60.3[2/]	67.4[2/]	51.1	63.4
1970	100.0	[3/]	[3/]	[3/]	[3/]	56.5[4/]	70.2[4/]
Unit labor cost (in U.S. dollars at current exchange rates[5/])							
1964	100.0	34.1	43.4	57.4	64.1	57.8	71.7
1965	100.0	36.8	46.8	61.3	68.3	65.2	80.8
1966	100.0	34.3	43.7	67.0	74.8	65.7	81.5
1967	100.0	29.4	37.5	59.9	66.8	57.6	71.4
1968	100.0	30.0	38.2	52.8	58.9	53.3	66.1
1969	100.0	27.8	35.4	51.9[2/]	57.8[2/]	51.9	64.3
1970	100.0	[3/]	[3/]	[3/]	[3/]	61.8[4/]	76.7[4/]

[1/] Excluding wire and wire products in the United Kingdom and wheels and axles in West Germany. The ranges in estimates do not allow for differences between the countries in the degree of vertical integration or the quality of steel produced.

[2/] Preliminary.

[3/] Not available.

[4/] Preliminary estimates based on 9 months of 1970.

[5/] Exchange rates: U.S. $1=360 yen, 0.3584 pounds in 1964-1966, 0.3643 pounds in 1967, and 0.4167 pounds in 1968-1969; 4.0 marks in 1964-1968, 3.94 marks in 1969, and 3.66 marks in 1970.

NOTE: With the exception of a few items, the estimates for 1964 are based on the U.S. definition of the iron and steel industry. These estimates were adjusted for intercountry differences in product mix. Comparative 1964 data for the United States, the United Kingdom, and West Germany are from "An International Comparison of Unit Labor Cost in the Iron and Steel Industry, 1964: United States, France, Germany, United Kingdom" (BLS Bulletin 1580, 1968), while comparative 1964 data for Japan are preliminary unpublished estimates.

Estimates for 1965 to 1970 were obtained by applying trend indexes for each country--unadjusted for comparability among the countries--to the 1964 relatives. The estimates for these years, therefore, are less reliable than the 1964 comparison.

Prepared by: Bureau of Labor Statistics
Office of Productivity and Technology
Division of Foreign Labor Statistics and Trade
May 11, 1971

(4) Other Factors Bearing on Import Competitiveness Vary in Implications

- There are probably no major differences in raw materials costs, although the U.S. does have an advantage in the availability of coking coal. The cost of coking coal has, however, increased sharply due mainly to rising export demand, cost increases imposed by new mine safety regulations, and environment-related increases in demand for low sulphur coal.

- Capital costs abroad are significantly lower than in the U.S. Rough estimates place relative capital costs per ton of raw steel produced as follows:

  - United States: $350
  - Western Europe: $220
  - Japan: $135

- Freight rates on inbound steel shipments are a factor. Conference rates from Western Europe are $30-$44 per ton, but lower rates can be obtained on non-conference ships reportedly as low as $11-$13 per ton in some cases. Data on Japanese freight costs, where movement is on Japanese vessels, are not available.

- Prior to the imposition of the 10% surcharge, tariffs on most steel products were moderate, generally ranging from 7.5 to 10% ad valorem.

(5) Price Differentials With Japanese Imports May Be 20% or More With Narrower Differentials for European Steels

There are simply no reliable data permitting comparison of prices of imported duty-paid steel to domestic prices. However, the price gap with Japan has apparently been of the order of 20% or more, though there is some indication that it may be narrowing. The price differential for European steel is estimated to be generally narrower, though European producers may seek to meet Japanese prices in order to utilize surplus capacity.

VI. STEEL INDUSTRY FINANCIAL PERFORMANCE

Steel industry net earnings peaked in 1966 at more than $1.1 billion. In 1970, industry net earnings were $563 million, roughly one-half the level reached in 1966. At no time during the period 1967-1970 did industry earnings equal the 1966 high.

The decline in steel industry profits has been accompanied by a general erosion of financial resources as maintenance of dividend payouts in the face of a decreasing cash flow and continuing high levels of capital expenditures have forced producers to take on increasing amounts of long-term debt.

Stockpiling of steel in anticipation of a strike permitted the industry to obtain high levels of production during the first half of 1971. Prospects for the balance of the year, however, are bleak with the industry operating at little more than 50% of capacity as customers work down steel inventories accumulated during the stockpiling period.

1. STEEL INDUSTRY PROFITS HAVE DECREASED SHARPLY FROM LEVELS OBTAINED IN THE MIDDLE 1960'S

Exhibit XV, following this page, charts the pattern of steel industry net profits during the 1960's. During the boom period of the early to middle sixties, profits rose rapidly to the 1966 peak of $1.1 billion. From 1968 to 1970, profits declined rapidly to $563 million, the lowest point of the decade.

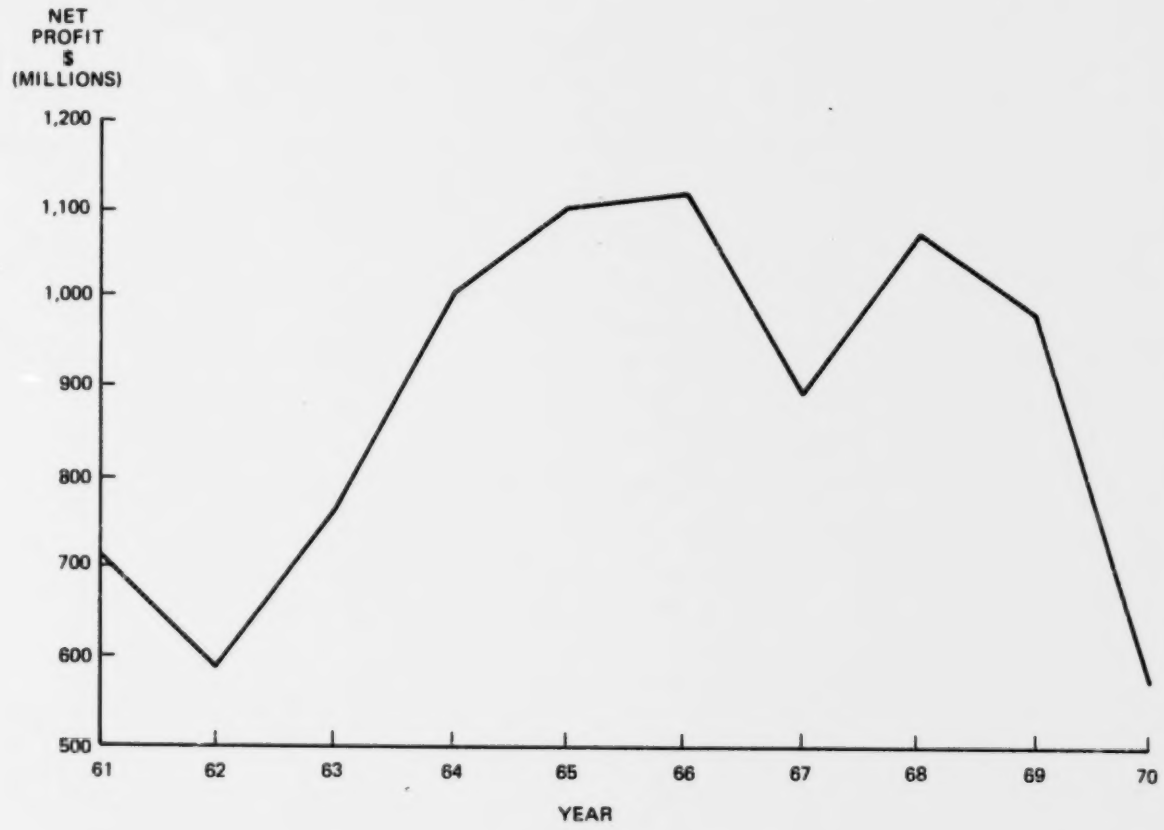
(1) Profit Margins as Well as Profits Have Decreased Substantially

Accompanying the downturn in industry, dollar profits have been a significant erosion in profit margins, or industry return on sales. Table III, below, shows that, while total revenues increased from 1968 to 1969 and decreased slightly in 1970, pre-tax profit margins declined steadily to little more than half the 1968 level.

EXHIBIT XV

Council on Environmental Quality

STEEL INDUSTRY NET PROFITS
1961-1970



SOURCE:
INDUSTRY WEEK – FINANCIAL ANALYSIS OF THE STEEL INDUSTRY, APRIL 12, 1971.

Table III

Steel Industry Revenues and Pre-Tax Profits*

Year	(Millions of $) Revenues	Pre-Tax Profit	Pre-Tax Profit as a % of Revenues
1970	$19,117	$1,073	5.6%
1969	19,231	1,683	8.8
1968	18,680	1,862	10.0

*Source: American Iron & Steel Institute

(2) Steel Industry Profitability Compares Unfavorably With the Profitability of Other Manufacturing Industries

Exhibit XVI, following this page, compares steel industry profit ratios with those achieved by all manufacturing companies. From 1961 to 1966, steel industry profit margins exceeded those prevalent in all manufacturing. After 1966, however, steel industry margins steadily lost ground to 1970 when they were little more than 60% of profit margins for all manufacturing companies.

Although industry profit margins have decreased substantially since 1966, they remain generally higher than margins achieved by major foreign producers. (See Exhibit XVII, following Exhibit XVI.)

2. RETURN ON INVESTMENT IN THE STEEL INDUSTRY HAS DECREASED SIGNIFICANTLY REFLECTING LOWER PROFITABILITY

Accompanying the decrease in steel industry, profitability discussed above has been a steady decline in industry rate of return on investment. Exhibit XVIII, following Exhibit XVII, charts industry return on equity (net worth) and return on total invested capital from 1961 through 1970. A comparison with movements of steel industry profits shows, as might be expected, that return on investment performance was roughly parallel.

EXHIBIT XVI

Council on Environmental Quality

COMPARISON OF STEEL INDUSTRY
PROFITABILITY WITH PROFITABILITY
OF ALL MANUFACTURING CORPORATIONS
1961 - 1970

Year	Profit Before Fed. Inc. Tax as a % of Sales		Net Profit as a % of Sales	
	Steel	All Mfg.	Steel	All Mfg.
1970	3.6	6.8	2.5	4.0
1969	7.0	8.3	4.4	4.8
1968	7.5	8.8	4.6	5.1
1967	7.5	8.3	4.8	5.0
1966	9.8	9.0	5.8	5.6
1965	9.9	9.5	5.7	5.6
1964	9.7	8.9	5.6	5.2
1963	9.1	8.5	4.8	4.7
1962	7.4	8.2	3.9	4.6
1961	9.1	7.7	4.6	4.3

EXHIBIT XVII

Council on Environmental Quality

LEADING FOREIGN STEEL PRODUCERS NET PROFITS AS A PERCENT OF SALES AND NET WORTH - 1970

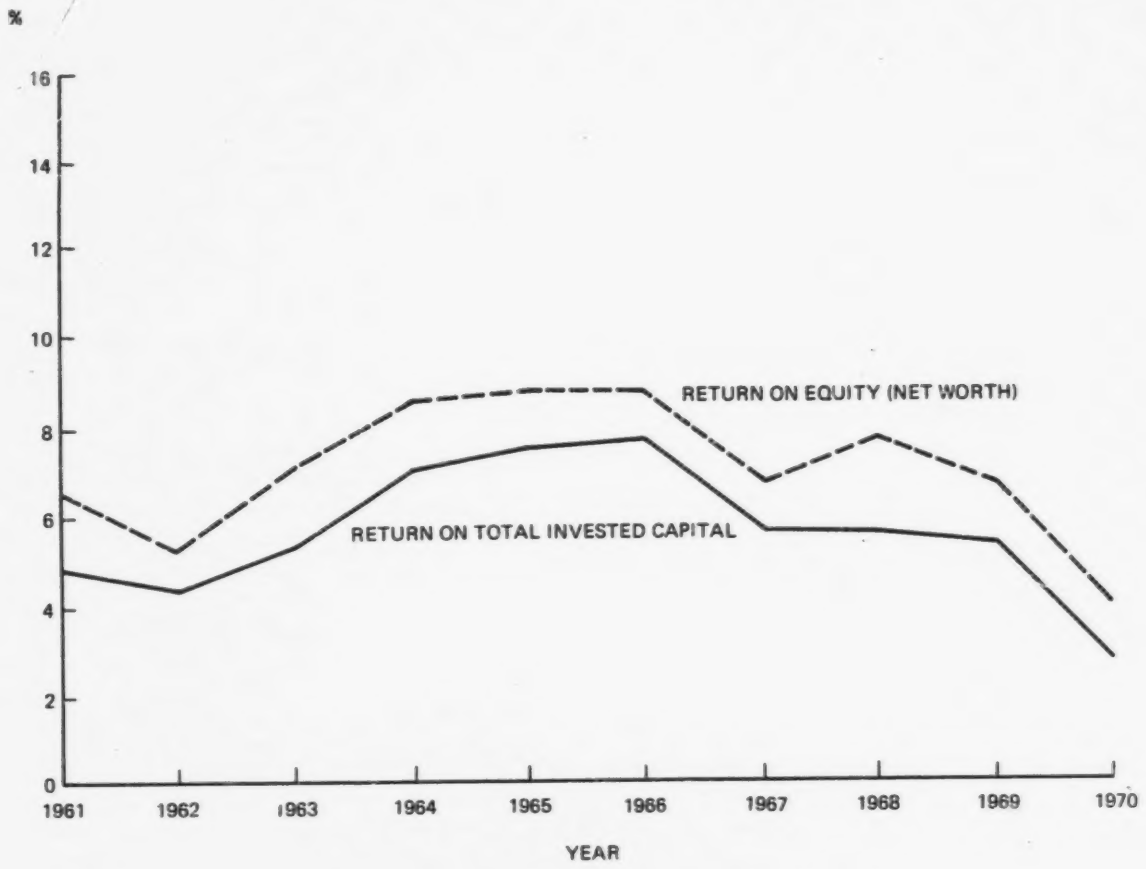
	Sales (000)	Net Profit (000)	Net Worth (000)	Net Return on Sales (%)	Net Return on Net Worth (%)
Japan					
Nippon Steel	$3,991,578	$74,989	$875,303	1.8	8.6
Nippon Koken	1,799,675	34,947	311,156	1.9	11.2
Sumito Metal Industries	1,573,302	26,852	296,293	1.7	9.1
Kobe Steel	1,426,581	26,700	297,925	1.9	9.0
West Germany					
August Tnyssen-Hutte	2,956,674	56,847	554,916	1.9	10.2
Krupp Konzern	1,648,902	25,886	180,525	1.6	14.3
France					
Wendel Sidelor	1,063,334	7,960	356,369	0.7	2.2
Usinor	954,955	41,151	322,724	4.3	12.8
United Kingdom					
British Steel	3,496,800	(24,000)	1,588,800	(0.6)	(1.5)
Luxemborg					
Arbed	1,334,480	39,812	421,148	3.0	9.5
Australia					
Broken Hill Proprietary	1,931,216	66,972	1,087,920	3.5	6.2

Source: Fortune, August, 1971

EXHIBIT XVIII

Council on Environmental Quality

STEEL INDUSTRY RATE OF RETURN ON
NET WORTH AND TOTAL INVESTED CAPITAL



Return on equity steadily increased during the early and middle sixties to a peak of 8.9% in 1966. By 1970, however, industry return on equity had declined to 4.0% which placed steel 40th among 41 manufacturing industries analyzed by First National City Bank.

While return on sales is higher in the U.S. industry than for leading foreign producers, return on equity (net worth) for leading foreign producers in 1970 was significantly higher than the U.S. industry average. (See Exhibit XVII, following page 25.) The high rates of return achieved by Japanese and West German steel companies reflect the large percentage of long-term debt in relation to total invested capital traditionally carried by these companies. As an example, in 1969, long-term debt was equal to 68% of total invested capital for Nippon Koken, as opposed to only 30% for U.S. Steel. Of course, the price paid by these debt heavy companies at least by U.S. standards, is a relatively greater vulnerability to decreases in steel demand or steel prices.

3. DECREASING PROFITS ACCOMPANIED BY HEAVY CASH EXPENDITURES HAVE ADVERSELY AFFECTED THE STEEL INDUSTRY'S FINANCIAL POSITION

In the face of decreasing profits and cash flow, the U. S. steel industry has maintained a high level of dividend payouts and capital expenditures at the cost of an increasing long-term debt burden and corresponding high levels of interest expense.

(1) Dividend Payouts and Capital Expenditures Have Remained High Despite Sagging Profits

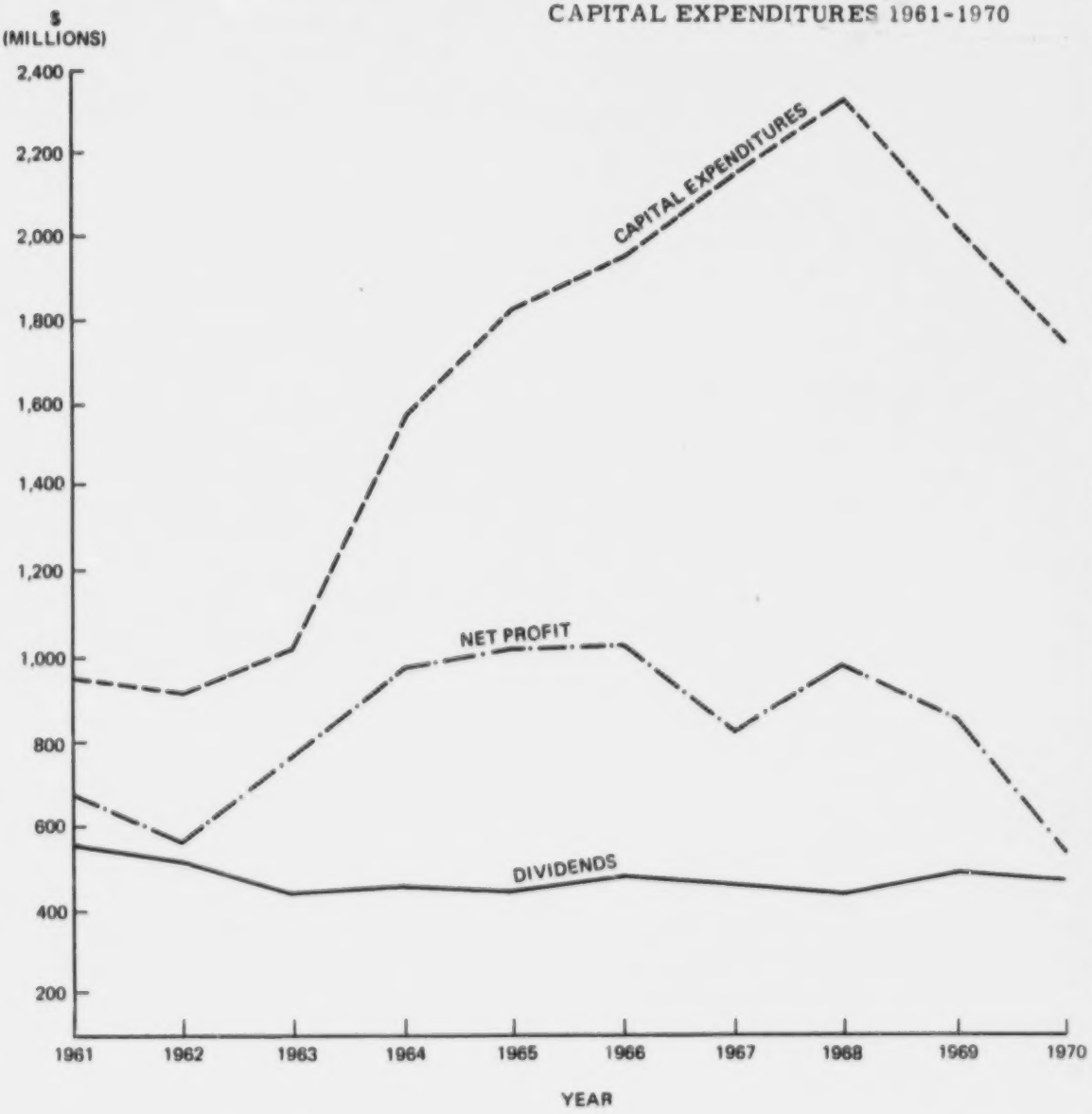
Exhibit XIX, following this page, charts the pattern of industry profits, dividend payments, and capital expenditures from 1961 through 1970. Capital expenditures took off during the boom period of the sixties and increased rapidly to a peak of $2.3 billion in 1968. From 1968 to 1970 as industry profits decreased sharply, capital expenditures remained at a high level dropping only to $1.7 billion in 1970. Maintenance of a high level of capital expenditures through 1970 reflects, in part, cash layouts to complete projects begun in earlier years. For 1971, industry capital expenditures are projected to be $1.6 billion, a decrease of approximately $135 million from 1970.

Despite sagging profits, dividend payouts remained relatively stable. Cash dividends paid in 1970, the worst year of the decade for the industry, equaled 94.6% of net income for that year and actually

EXHIBIT XIX

Council on Environmental Quality

PROFITS, DIVIDENDS, AND
CAPITAL EXPENDITURES 1961-1970



exceed by $2.2 million dividends paid in 1966, the best year of the decade for the industry. Cash dividends for 1971 should decrease substantially, however, as major producers have announced significant first and second quarter dividend cuts.

(3) Since 1964, Industry Cash Outlays Have Exceeded Internal Cash Flows

Exhibit XX, following this page, shows industry net internal cash flows, dividends, and capital expenditures for the period 1961 to 1970. Since 1964, cash outlays have exceeded internally generated cash flows by a margin which has increased yearly through 1970. From 1961 through 1970, total cumulative cash outlays exceed internally generated cash flows by $1.8 billion.

(4) The Increasing Excess of Cash Outlays Over Internally Available Cash Has Caused the Industry To Take on Increasing Burdens of Long-Term Debt

Exhibit XXI, following Exhibit XX, shows the mounting burden of long-term debt, and interest expense accumulated by the steel industry from 1961 to 1970. From a low of $2.7 billion in 1963, long-term debt has increased to $5.2 billion in 1970, almost doubling over the 7-year period. Interest expense, due to a combination of increasing long-term debt and higher interest rates, more than doubled over the same period from $128 million to $288 million. Interest expense as a percentage of net profit increased from 16.3% in 1963 to 56.2% in 1970, reflecting both increased interest expense and lower operating profits.

Long-term debt as a percentage of net worth increased from a low of 24.5% in 1963 to a high of 40.1% in 1970. Over the same period, long-term debt as a percentage of total invested capital increased from 19.7% to 28.6%. Comparable percentages for all manufacturing in 1970 were 33% and 29%, respectively.

EXHIBIT XX

Council on Environmental Quality

STEEL INDUSTRY NET INTERNAL CASH FLOWS
1961 - 1970
(Millions of $)

Year	Net Profit	Depreciation Depletion, etc.	Changes in Reserves	Cash Flow	Dividends	Capital Expenditures	Annual Net Internal Cash Flow
1970	$ 513	$1,043	$ 78	$1,634	$(485)	$(1,735)	$(586)
1969	879	1,042	131	2,052	(489)	(2,047)	(484)
1968	992	966	350	2,308	(452)	(2,307)	(451)
1967	830	1,202	242	2,274	(481)	(2,146)	(353)
1966	1,075	1,172	27	2,274	(483)	(1,953)	(162)
1965	1,069	1,102	15	2,186	(467)	(1,823)	(104)
1964	992	1,062	(16)	2,038	(462)	(1,600)	(24)
1963	782	996	38	1,816	(443)	(1,040)	333
1962	566	929	29	1,524	(508)	(911)	105
1961	690	740	9	1,439	(557)	(960)	(78)

Source: Derived from American Iron & Steel Institute data.

EXHIBIT XXI

Council on Environmental Quality

STEEL INDUSTRY LONG-TERM DEBT, INTEREST AND DEBT, AND DEBT AS A PERCENTAGE OF NET WORTH AND TOTAL INVESTED CAPITAL 1961-1970
(Millions of $)

Year	Long-Term Debt	Interest Expense	Average Interest Rate	Long-Term Debt as a % of Net Worth	Long-Term Debt as a % of Total Invested Capital
1970	$5,157	$288	5.6	40.1	28.6
1969	4,609	246	5.3	35.9	26.4
1968	4,601	225	4.9	36.5	26.7
1967	4,205	185	4.4	34.6	25.7
1966	3,782	178	4.7	31.4	23.9
1965	3,120	137	4.4	25.9	20.6
1964	2,874	129	4.5	25.2	20.1
1963	2,695	128	4.7	24.5	19.7
1962	2,853	132	4.6	26.7	21.1
1961	2,969	123	4.1	27.9	21.8

4. MARKET PERFORMANCE OF STEEL INDUSTRY SECURITIES REFLECTS INDUSTRY FINANCIAL PROBLEMS

Reflecting announced dividend cuts, steel stocks fell to near 15-year lows in prices and multiples by July of this year. From January to July 1971, while the S&P 425 Index rose 8.0%, the steel index declined by 8.1%. In some cases, steel stocks fell to one-half to one-third of book value. Following the announced price-wage freeze, the steel index rose by 16.5%, compared to 7.4% for the market as a whole. By September 15, steel stocks were trading at levels 15% to 20% above preannouncement levels. The reasons advanced by analysts for this modest recovery are as follows:

- The announcement of the import surtax
- Removal of the 7% excise tax on automobiles
- Restoration of the investment tax credit

Analysts point out, however, that steel stocks are purchased for their dividend yield. Thus, price is related to anticipated divident yield. Because of this, steel companies have historically paid out about 50% of their yearly earnings in dividends. As a result, significant dividend cuts, over time, to improve the industry's financial position would inevitably be reflected in declining stock prices.

Analysts generally agree that raising funds in the equity market is not a feasible alternative for the steel industry.

The increasing long-term debt burden carried by the industry, as well as the decline in industry profits, has been reflected in the bond market. In 1971, U.S. Steel, as a result of a $150 million public debt offering, had its bond rating reduced from AA to A due to a decreased interest coverage. Analysts contacted feel that a number of other major producers would be faced with a similar situation were they to go to the public debt market at this time.

The cost to the steel industry of raising new debt is estimated to be 8.5%-9.0%. In addition, analysts point out that debt acquired during the 1960's is beginning to mature. The cost of "rolling over" this debt at higher interest rates should result in increased industry interest costs, even if no additional debt is acquired.

5. UNDERLYING THE STEEL INDUSTRY'S POOR FINANCIAL PERFORMANCE ARE PROBLEMS OF FLAT DEMAND, IMPORT COMPETITION AND RISING COSTS OF PRODUCING STEEL

Problems of demand, import penetration, and lagging productivity have been discussed in detail in the preceding chapters. Contributing significantly to lagging profitability, however, have been sharp increases in labor and materials costs. Total fixed costs have also increased significantly, adding to the burden of per unit fixed losts, resulting from inefficient capacity utilization.

(1) The Steel Industry Experienced Substantial Cost Increases in Material and Service Costs From 1968 to 1970

Exhibit XXII, following this page, compares percentage price changes of major materials and services purchased by steel companies from June 1968 to December 1970. Leading the advance were prices for residual fuel oil and most important coking coal which increased by 66.6%. For larger producers with captive coal supplies, the impact of the increase in coal prices was, of course, minimized. For those producers required to purchase coal, however, the impact was significant. The estimated increase in the cost of all purchases for a representative steel producer from mid-1968 to the end of 1970 is on the order of 20%.

From 1968 to 1970, the cost of purchased materials and services has increased from 46% of total revenues to 47.5%. Since these costs, on the average, are relatively stable per ton of output, it is clear that they have only been partially covered by steel price increases. As will be discussed below, compensatory changes in per unit labor costs and/or burden (fixed charges absorbed) have not occurred.

(2) Steel Industry Employment Costs Have Increased Sharply

From 1965 to 1970, total steel industry employment costs increased from 36.3% of total revenues to 40.0% in the face of decreasing levels of employment. Compared to 1965, employment in 1970 had decreased by 48,000 workers or 6.6%. Man-hours worked

EXHIBIT XXII

Council on Environmental Quality

PERCENTAGE CHANGES IN PRICES OF SELECTED COMMODITIES AND SERVICES PURCHASED BY STEEL COMPANIES
JUNE 1968-DECEMBER 1970

Item	Price Change (%)
Iron and Steel Scrap	+40.1
Coal--Metallurgical (Medium and Low Volatile)	+66.6
Tin--Pig, Grade A	+15.2
Nickel--Primary Cathode Sheets	+41.5
Zinc--Slab--Prime Western	+10.7
Natural Gas	+ 5.8
Electricity--Industrial	+ 9.2
Residual Fuel Oil	+72.9
Rail Freight Rates	
Scrap	+38.0
Ore	+29.8
Coal	+27.3

Source: American Iron and Steel Institute

had decreased by 106 million or 7.5%. On the other hand, payrolls for 1970 were $662 million or 11.7% higher than in 1965. Average hourly employment costs were $5.66 in 1970 compared to $4.48 in 1965, an increase of 26.9%.

Increases in productivity (output per man-hour) were nowhere sufficient to offset increased labor costs. Productivity in 1970 was only 7/10 of a percentage point higher than in 1965. Productivity peaked during this period in 1969 at 104.8 (1967=100) an increase of only 3.7% over 1965, but dropped to 101.8 in 1970.

The causes of the disappointing productivity performance are complex and cannot be examined in depth within the scope of this study, however, the following elements contributed to the problem:

- Lack of growth and inefficient capacity utilization levels
- New equipment break-in problems
- An increasingly complex mix of products by grade and quantity

(4) Fixed Charges Have Remained Stable in Relation to Volume

From 1965 to 1970 fixed charges (interest, depreciation, and amortization) actually decreased slightly as a result of changes in methods of computing depreciation. However, interest expense increased by 110% during this period as long-term debt levels and interest rates both rose.

Reported fixed charges as a percentage of volume are about the same in 1970 as in 1965. However, had uniform depreciation methods been employed, 1970 would show a slight increase. Interest charges during this period increased from .9% of revenue to 1.5%.

Had volume increased at 2-3% per year from 1965 through 1970, allowing for steel price increases, fixed charges would most probably have decreased in relation to volume.

5. FOR 1971, STEEL INDUSTRY PERFORMANCE SHOULD FALL BELOW 1970 LEVELS *

While the level of production achieved during the first half of 1971 was high as steel inventories were accumulated in anticipation of a strike, the level of production during the second half of the year has fallen to such a low level that estimates for total net shipments for 1971 are less than 90 million net tons. Added to the burden of low-capacity utilization have been continued increases in labor and materials costs since the end of 1970.

(1) Major Materials Costs Have Continued To Increase Since the End of 1970

Table IV, below, shows the price changes from December 1970 to September 1971 in major materials purchased by steel producers:

Table IV

Percentage Prices Changes
for Major Materials and Services
Purchased by Steel Companies
December 1970 - September 1971

Materials	Price Change (%)
Iron and Steel Scrap	(6.7)
Coal - Metallurgical	9.6
Tin - Pig, Grade A	(4.1)
Nickel - Primary Cathode Sheets	-0-
Zinc - Slab, Prime Western	9.6
Natural Gas	6.7
Electricity - Industrial	7.8
Residual Fuel Oil	4.7

Source: Bureau of Labor Statistics

Except for imported materials, these increases have been checked, for the time being, by the wage-price freeze schedule to expire in November. Since the policies to be followed under Phase II of the President's economic program are not yet known, there is no basis for judging whether further increases in the prices of these materials will occur, nor the extent to which compensatory adjustments in steel prices will be permitted.

* See letter of transmittal for actual 1971 results and explanations

While volatile scrap and tin prices have declined, the prices of other purchased materials have continued to increase at a rapid rate.

(2) The 1971 Steel Industry Wage Settlement Has Resulted in Substantial Labor Cost Increases

The recent wage settlement has resulted in an approximate 15% first-year increase in average hourly total employment cost for steel industry wage earners. The full impact of this settlement will be felt over the last four months of the year when industry capacity utilization and labor productivity will be at their lowest.

(3) Increased Imports Have Limited Domestic Shipments

By the end of August, steel imports for 1971 had exceeded 12 million tons, reflecting the stockpiling during the first half of the year. By the end of the year, imports are likely to exceed 15 million tons; up from 13.7 million tons in 1970.

Because of increased costs and lagging production, industry profits for 1971 should be even lower than the dismal levels achieved during 1970. The probability is also high that some companies will report net losses for 1971.

6. FOR 1972 AND LATER YEARS, PROSPECTS FOR INCREASED OUTPUT AND PROFITS APPEAR GOOD

Growth in steel demand should resume in 1972 and continue through 1976. Import penetration should stabilize or even decrease with the realignment of world currencies, especially in regard to West Germany and Japan; 10% import surcharge as long as it lasts; and the possible extension of the Voluntary Restraint Arrangements on more favorable terms.

The above conditions appear to set the stage for a resumption of growth and more profitable operations for the domestic steel industry.

VIII. STEEL PROCESSING AND ASSOCIATED WASTE PRODUCTS

1. THE MAKING OF STEEL INVOLVES PRODUCTION STEPS RANGING FROM THE EXTRACTION OF RAW MATERIALS FROM THE GROUND TO THE SHAPING AND TREATING OF FINISHED PRODUCTS

The specific aspects of steel production to be considered in this chapter are those which take place in an integrated steel plant. (See Exhibit XXIII, following this page.)

All of these processing steps involve waste products which would exceed allowable concentration limits in either the atmosphere or water if they were allowed to escape untreated. The wastes present, and their proportions depend on raw material composition, operating techniques, and the size and type of equipment used in producing steel products.

(1) Iron Ore May Be Sintered (Fused) Before Charging Into the Blast Furnace

Sintering of ore involves a number of steps which in relation to other processing does not contribute a large amount of waste. (See Exhibit XXIV, following Exhibit XXIII.) The basic process consists of heating ore particles so they will fuse together into lumps which facilitates furnace operations. Ore particles that do escape into the air are collected for reuse. This does not cause appreciable wastes.

(2) Limestone Is Used To Improve the Fusibility of Impurities

Limestone provides a substance which impurities will combine with in preference to the iron being made. Except for grinding, limestone is basically used in the same form as mined.

EXHIBIT XXIII

Council on Environmental Quality

STEEL MANUFACTURING FLOW CHART

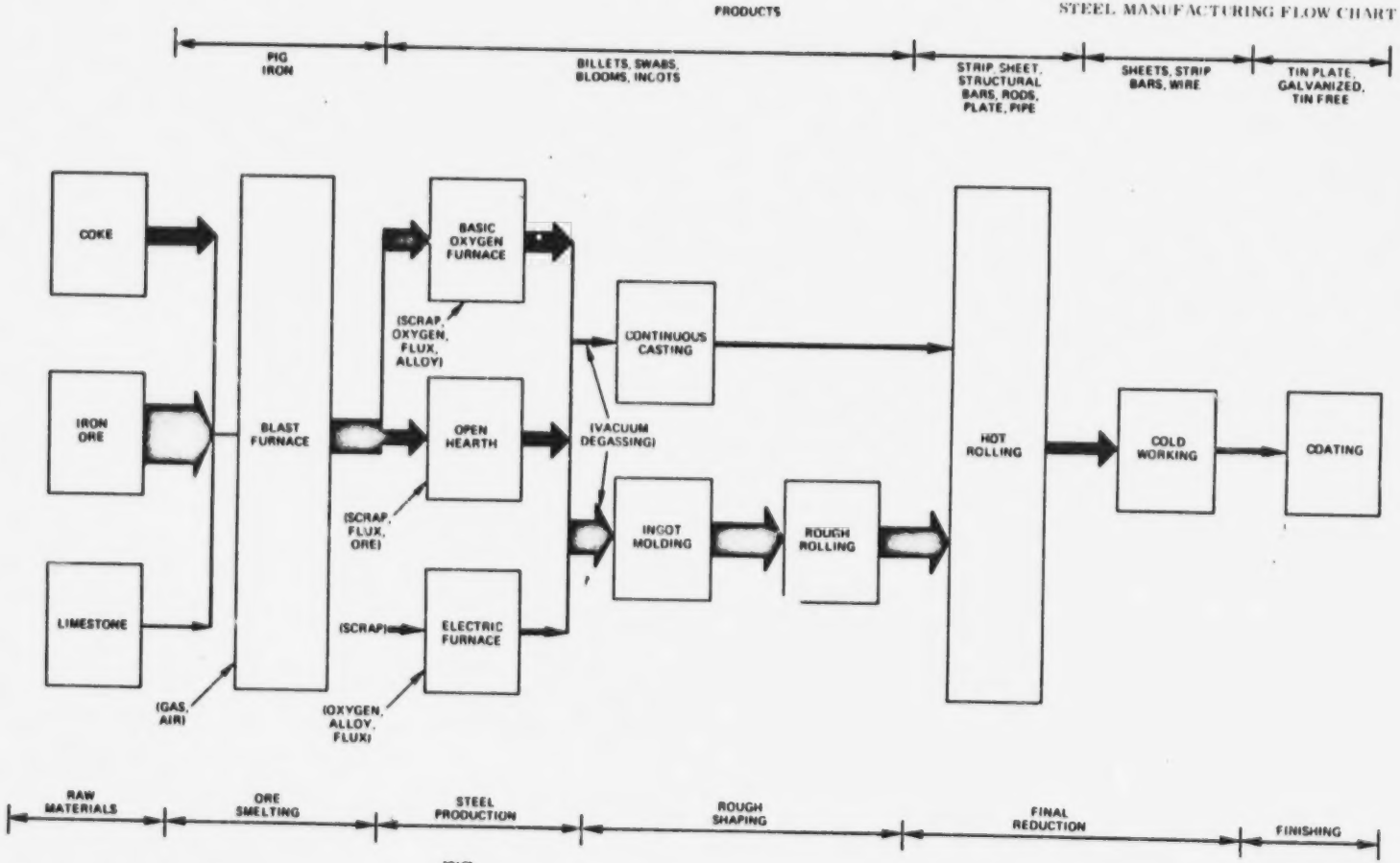
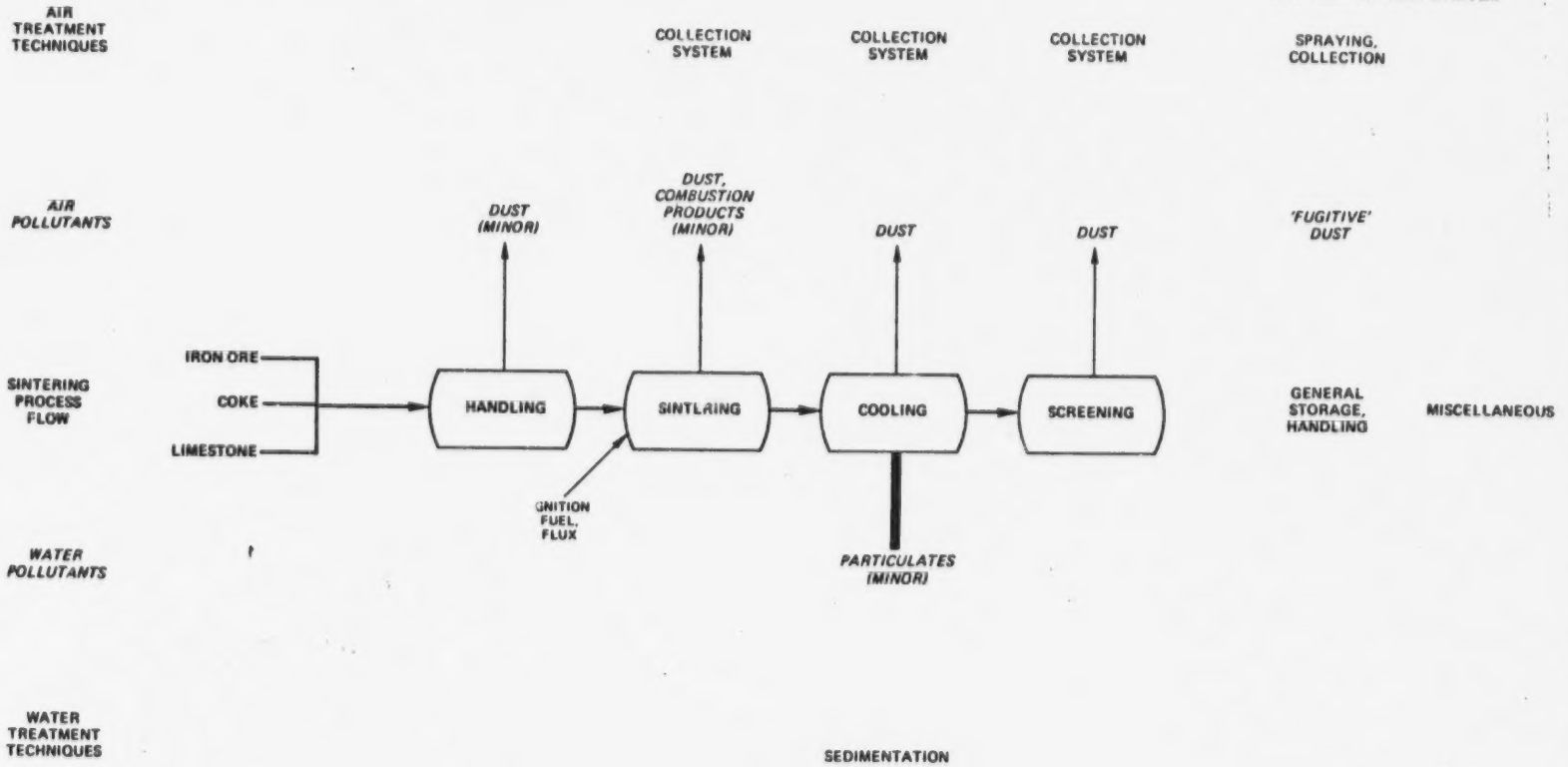


EXHIBIT XXIV

Council on Environmental Quality

SINTERING PROCESS FLOW AND ASSOCIATED WASTES



(3) Coke Is the Basic Source of Heat in the Blast Furnace and Provides the Carbon Which Acts as an Ore Reducing Agent

Coal is converted into coke by heating it in the absence of air. There are several points in this conversion process that contribute significant waste products (see Exhibit XXV), following this page). Several of these products are collected and processed to produce usable or salable commodities, e.g., gas, tar, ammonia liquor, ammonium sulfate, and light oil. There is, however, a quantity of these products in addition to dust and smoke which escape and must be collected and treated.

(4) Blast Furnace Operation Consists of Smelting the Ore To Produce "Pig" Iron

Ore, coke, and limestone are combined in the blast furnace and a hot "blast" of air ignites the coke and provides oxygen for combustion. The air picks up ore and other particles which go up the stock (see Exhibit XXVI, following Exhibit XXV). This hot air has a value and is of use in preheating the combustion air and for other plant purposes. In order to be used, however, the particles must be removed. These particles are subsequently sintered for reuse.

Furnace blowdown (cleaning of walls) done with steam produces water wastes which may require biological treatment.

Conversion of ores that have been highly purified directly to steel in an electric furnace direct reduction is not felt to be practical for high volume production in the near future. Small installations have been made, however, and are relatively free of excessive emissions.

EXHIBIT XXV

Council on Environmental Quality

COKING PROCESS FLOW AND ASSOCIATED WASTES

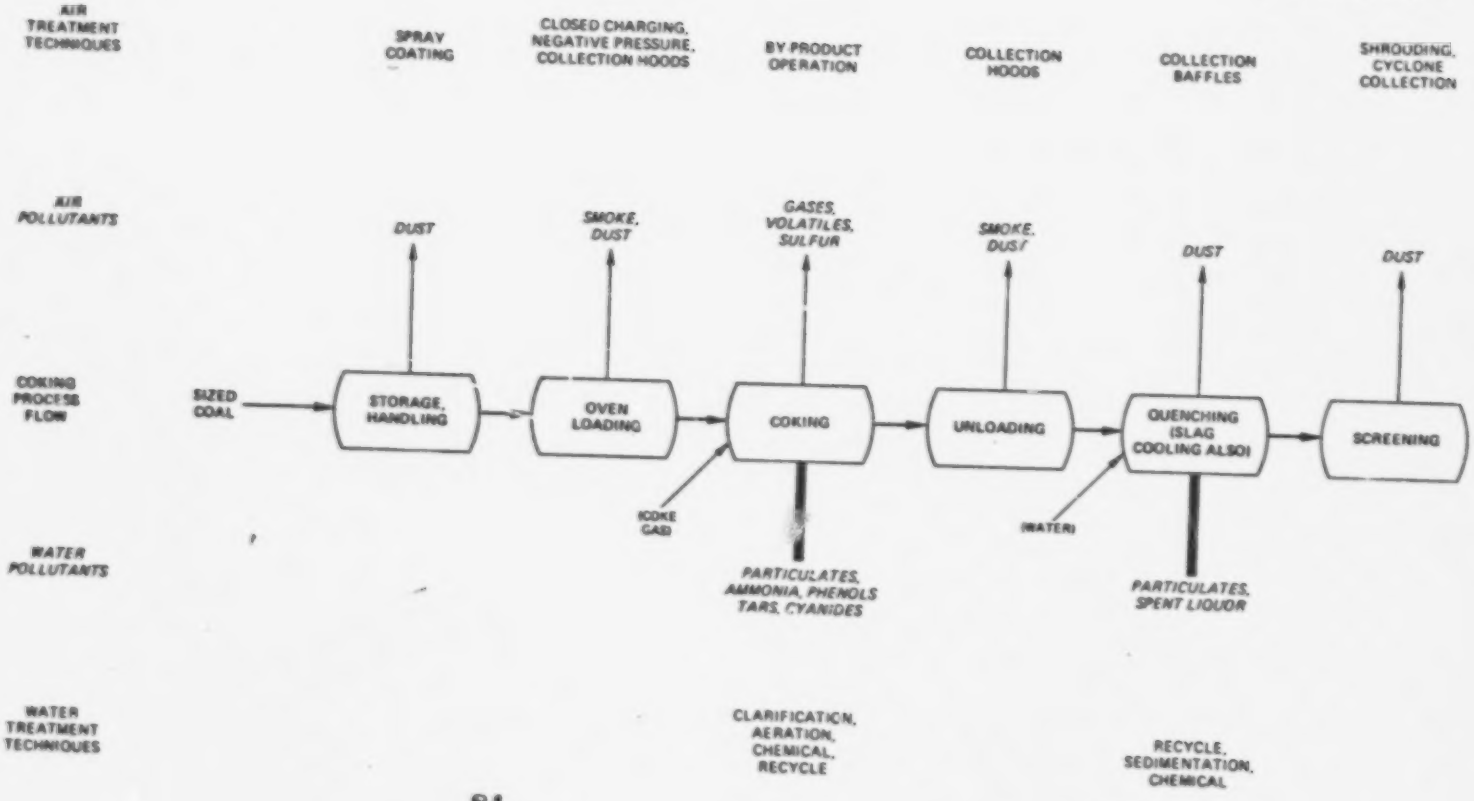
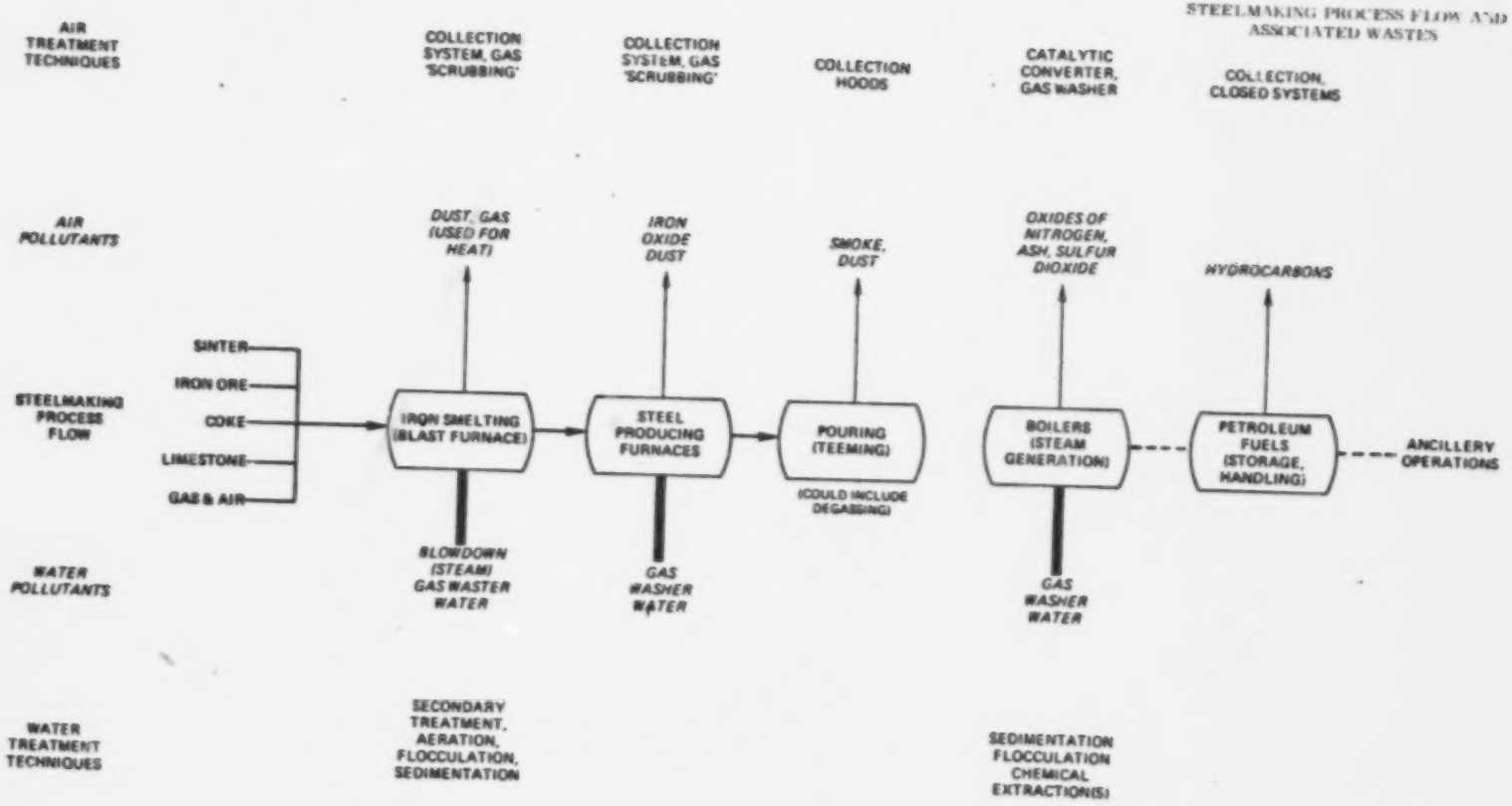


EXHIBIT XXVI

Council on Environmental Quality

STEELMAKING PROCESS FLOW AND ASSOCIATED WASTES



(5) Steelmaking Furnaces Convert Pig Iron, Scrap, and Alloys Into Steel of Desired Composition

Basic steelmaking operations produce emissions of iron oxide particles. The quantity of emissions, however, varies considerably depending on the process used:

- Open hearth furnaces use gas heat to convert scrap, limestone, and solid or liquid iron into steel. Alloys occasionally are added. Gas flame and air impinge on the surface of the metal and conversion is accomplished relatively slowly with corresponding reduced levels of emission. This process, due to refinements in the basic oxygen process, is becoming less prevalent. The share of raw steel produced by this method has decreased from 84% in 1962 to 37% in 1970. It is doubtful if many new facilities will be constructed.

- Basic oxygen furnaces convert scrap and molten pig iron to steel by blowing large quantities of high purity oxygen onto the surface of the metal. This produces a rather violent reaction which releases large quantities of iron oxide. Since this process has a much higher production rate than open hearths, its share of production has risen from 7% in 1962 to 48% in 1970.

- Electric furnaces generally are charged with scrap and alloys to produce a variety of specialty steels. Electricity flowing through the metal produces heat which melts the metal. Various fluxes are used to facilitate the process. A minimum of emissions result due to the absence of pig iron and the method of heating. Electric furnace steelmaking has increased its share of production from 9% in 1962 to 15% in 1970.

(6) As Steel Is Poured From the Furnaces, It May Be Passed Through a Vacuum Atmosphere for Removal of Dissolved Gases

The gases collected are of sufficient low volume and toxicity that no specific treatment considerations are necessary.

(7) Casting and Primary Forming of Blooms, Billets, and Slabs Which Are the Basic Semi-Finished Steel Shapes Involve Minimal Wastes

Primary shaping operations are accomplished in one of two ways:

- Ingot casting involves pouring steel into a mold and allowing it to solidify. The molds are then removed and ingots are heated to a uniform rolling temperature throughout. Ingots are reduced in cross-section by rolling to a convenient size for further processing. Pollutants generated by this process are minimal, but heat cutting and repair work on the surface of the steel (scarfing) produce smoke and fumes which require control.

- Continuous casting is a process whereby molten steel is continuously formed into shapes similar to those produced by primary rolling. This eliminates ingot handling and the initial sizing operations. Again, pollutants are restricted to smoke and fumes generated by heating or cutting torches. Today, little more than 10% of steel is continuously cast, but it is estimated that by 1975 as much as 25% may be processed this way, if existing technical problems are solved.

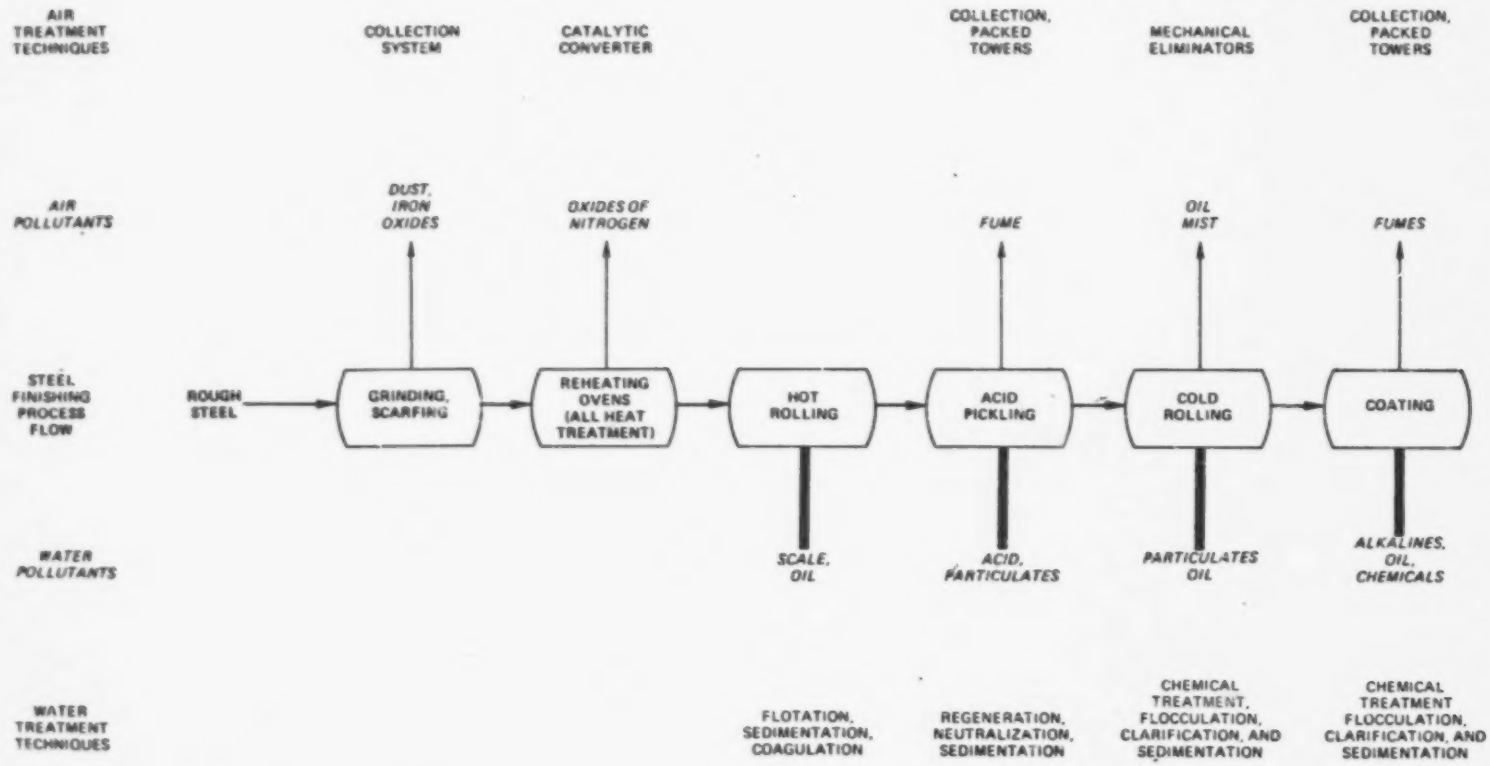
(8) Reheating of the Ingots for Primary Rolling, Heating of the Semi-Finished Shapes for Hot Rolling, and Heat Treating of Finished Products Produce Nitrogen Oxides

These oxides are the result of burning natural fuels, e.g., gas, oil, coal, and require control (see Exhibit XXVII, following this page). In addition, boiler operation for the production of steam generally involves use of natural fuels which also produces nitrogen oxides.

EXHIBIT XXVII

Council on Environmental Quality

STEEL FINISHING PROCESS FLOW AND ASSOCIATED WASTES



(9) Hot Rolling Is The First Step in Producing a Usable Product

After primary rolling and during reheating, an oxidized layer (scale) forms on the surface of the metal and must be removed and washed away. Considerable quantities of water are used to blast this layer off and to carry it to appropriate treatment facilities. Treatments include particle removal and oil separation.

(10) Cold Rolling and Drawing May Be Required To Achieve Final Sizing and Surface Characteristics

Before cold working can proceed, the surface of the steel must again be treated to remove scale. The process used is pickling. This involves passing the metal through an acid solution and then rinsing it. The acid wastes must be treated for particulates and to reduce acidity.

Subsequent to pickling, the surface of the steel must be prepared for further processing. If cold rolling is to be done, a lubricant mist is sprayed onto the metal surface. Any excess must be collected. If drawing is the next step, an alkaline coating is used to reduce acidity, prevent rust, and ease lubrication. Alkaline wastes can be used to neutralize acid wastes.

(11) Final Surface Cleaning for Shipment or for Subsequent Coatings Contributes Water Wastes

Particulate matter and alkaline and oil wastes are the result of cleaning dirt and oil from the metal surface. The treatment required is of the same nature as other wastes produced in the finishing operation.

(12) Metallic and Other Chemical Wastes Are Produced by Galvanizing, Tinning, and Other Metallizing (Casting) Lines

The waste water from these operations contains tin, zinc, copper, fluorides, chromates, cyanides, alkalies, and acids. Waste flows vary with size and type of installation, but generally these

operations carry concentrations of toxic contaminants that exceed permissible limits. Basic control techniques involve chemical treatment to destroy or precipitate toxic compounds.

(13) Other Areas Involving Minimal Emissions May Require Specialized Treatments

These include:

- Petroleum product storage--Hydrocarbons which evaporate from fuels, e.g., gas, kerosene, benzene may require closed handling and/or collection.
- Raw material storage piles--Some spraying of surfaces is presently done to reduce wind loss. Enclosed storage is an expensive alternative.
- Miscellaneous handling and processing--Dust, smoke, and fumes may require collection in specific areas of high concentration.

2. WASTE WATER TREATMENT TECHNIQUES, IN GENERAL, ARE WELL DEFINED AND USED TO VARYING DEGREES IN ALL STEEL PLANTS

Treatment techniques fall into three main categories:

- Settling of suspended solids
- Skimming of surface residue
- Addition of chemicals

Amounts of water wastes generated per ingot ton of steel produced are summarized in Table V below:

Table V

Waste Loads Per Ingot Ton of Steel

Waste	Pounds/Ton
Suspended Solids	125.0
Phenols	0.064
Cyanides	0.028
Fluorides	0.031
Ammonia	0.078
Lubricating Oils	2.72
H_2SO_4	3.54
$FeSO_4$	13.2
Emulsions	0.414
Chromium	0.063
Tin	0.016

It can be seen that the quantity of pollution emitted is considerably less than one pound per ton except for particulates, suspended oils, and the pickling wastes.

Suspended solids and emulsions, in particular, appear to become more significant as technology advances. The use of more oxygen in processing and more lubricants in forming are felt to contribute to this trend.

In general, chemicals from coking and associated by-product operations, furnace gas washer water, mill water, along with cleaning and casting wastes contribute the bulk of wastes.

It is estimated that about 20,000 gallons of water per ingot ton produced must be treated in one way or another. Almost 50% of this water comes from the hot milling operations with the rest equally divided between furnace operations and other plant processes.

The relative quantities of water effluent from various operations must be viewed in light of the percentage of product that is processed by each operation. Pickling is a major source of waste per unit produced, but only

32% of the product shipped is processed beyond hot rolling. Likewise, only 14% of steel produced is coated minimizing its total waste contribution.

On the other hand, coking, steelmaking furnaces, and hot rolling are associated with practically all production and proportionally contribute high waste flows.

(1) Various Treatment Techniques Have Different Waste Removal Efficiencies

Exhibit XXVIII indicates the efficiencies of commonly used treatment techniques in relation to production process and waste composition. Varying efficiencies for the same treatment methods and waste flows will occur with different production processes due to some differences in the waste volume or concentration of particle size. Adding additional levels of treatment increases removal efficiency. It appears, however, that incremental increases may be small relative to capital expenditures required. With respect to steelmaking, waste removal efficiencies of 80% or better are available.

(2) Waste Treatment Techniques Are Becoming More Sophisticated and Frequency of Use Is Increasing

Exhibit XXIX shows that the percentage of plants employing treatment technology is increasing. Also, the percentage of plants employing combinations of treatment methods and more advanced treatment techniques is increasing. This reflects both the commitment of industry to do a better job in this area, and the imposition of tighter regulations on the quality of plant effluent.

It should be pointed out that subsequent disposal of solid wastes collected during treatment is a problem in both water and air treatment. In general, disposal is accomplished by drying and burning, landfill, or dumping in the ocean. Seldom are wastes of sufficient quality or quantity to make them marketable.

EXHIBIT XXVIII

Council on Environmental Quality

EFFICIENCIES OF VARIOUS WATER POLLUTION ABATEMENT PROCEDURES

Removal Method and Source of Wastes	Normal Removal Efficiency for Indicated Waste					
	Suspended Solids	Lube Oils	Acids	Soluble Metals	Emulsions	Coke Plt. Chemicals
I. Plain Sedimentation:						
A. Blast Furnace and Sinter Plt.	93.8					
B. Hot-Rolling Mills	90.7	20.0				
II. Coagulation and Sedimentation:						
A. Plant Furnace and Sinter Plt.	98.2					
B. Hot-Rolling Mills	95.4	80.0				
C. Cold Mills	50.0					
III. Recirculation and:						
A. Plain Sedimentation:						
1. Blast Furnace and Sinter Plt.	98.8					
2. Hot-Rolling Mills	96.9	60.0				
3. Cold Mills	50.0				75.0	
B. Coagulation and Sedimentation:						
1. Blast Furnace and Sinter Plt.	99.6					
2. Hot-Rolling Mills	98.4	90.0				
3. Cold Mills	80.0				95.0	
C. Magnetic Separators	80.0					
IV. River Water for Coke Quenching:						
A. Blast Furnace						90.0
V. Still Wastes for Coke Quenching:						
A. Coke Plant						92.7
VI. Biological Treatment						80.0
VII. Deep Well Disposal			85.0	100.0		100.0
VIII. Ion Exchange				95.0		
IX. Neutralization and Sludge Lagooning			80.0			
X. Regeneration Processes			80.0			
XI. Proper Operation of Facilities						

Source: "Cost of Clean Water" Vol. III, No. 1, U. S. Department of the Interior

EXHIBIT XXIX

Council on Environmental Quality

RELATIVE USAGES OF WATER POLLUTION ABATEMENT TECHNIQUES

Removal Method and Source of Wastes	Estimated Percentage of Plants Employing Method				
	1950	1963	1967	1972	1977
I. Plain Sedimentation:					
A. Blast Furnace and Sinter Plant	93	85	80	60	40
B. Hot-Rolling Mills	87	78	68	55	40
II. Coagulation and Sedimentation:					
A. Blast Furnace and Sinter Plant	0	4	5	15	25
B. Hot-Rolling Mills	0	1	2	5	10
C. Cold Mills	0	2	4	6	8
III. Recirculation and:					
A. Plain Sedimentation:					
1. Blast Furnace and Sinter Plant	5	8	10	15	20
2. Hot-Rolling Mills	10	15	20	25	30
3. Cold Mills	50	65	70	65	60
B. Coagulation and Sedimentation:					
1. Blast Furnace and Sinter Plant	2	3	5	10	15
2. Hot-Rolling Mills	3	6	10	15	20
3. Cold Mills	10	15	20	25	30
C. Magnetic Separators	5	10	15	20	30
IV. River Water for Quenching Coke:					
A. Blast Furnace	80	50	20	10	10
V. Still Wastes for Quenching Coke:					
A. Coke Plants	20	50	80	90	90
VI. Biological Treatment	0	5	10	15	20
VII. Deep Well Disposal	0	2	5	10	15
VIII. Ion Exchange	0	2	5	10	20
IX. Neutralization and Sludge Lagooning	10	50	80	85	75
X. Regeneration Processes	0	0	2	5	10
XI. Proper Operation of Facilities	20	35	50	60	70

Source: "Cost of Clean Water" Vol. III, No. 1, U. S. Department of the Interior

3. AIR POLLUTION IS GENERALLY DIFFICULT TO CONTROL AND REQUIRES MORE ADVANCED TECHNOLOGY THAN THAT REQUIRED TO TREAT WATER

The treatment of air falls into four basic categories according to type of emission. These emissions are dust (including iron oxide), hydrocarbons, sulphur and oxides of nitrogen, Exhibit XXX, following this page, shows basic emissions by production process and indicates the relative cost impact of abatement for each. Appropriate technology for control has generally been developed for each emission.

(1) Several Alternative Technologies Are in Use for Removal of Dust From Gas Emissions

Table VI, below, shows the quantity of dust emission by production process per ingot ton of output.

Table VI

Dust Emission Per Ingot Ton

Process	Pounds/Ton
Coking	15
Sintering	14
Smelting (blast furnace)	55
Steelmaking	
. Open Hearth	12
. Basic Oxygen	45
. Electric	12

The blast furnace and basic oxygen processes are the major sources of dust emissions. Steel industry representatives indicated that only the dust from the blast furnace and sintering operations can economically be recovered for reuse. Some instances were noted, however, of recycling dust from basic oxygen furnaces.

EXHIBIT XXX

Council on Environmental Quality

COST IMPACT AND TECHNOLOGY FOR PROCESSES REQUIRING AIR POLLUTION ABATEMENT

Process	Pollutants	Cost Impact	Control Technology
Storage of Kerosene, Benzene	Hydrocarbon	Minimal	Collection hoods
Basic Oxygen	Iron Oxide (no recycle benefit)	Minimal for new facilities	Collection hood
Electric	Minimal -- Some NOx	Minimal	Hoods
Open Hearth	Iron Oxide	High for existing facilities	Normal dust
Blast Furnace	Blowdown	High	Secondary treatment
Sintering	Fumes from oil in dust	Medium	Not well defined
Coke	Sulfur in gas	Very high	Several available but not in use
Boiler	Dust, smoke	Medium	Hood, etc.
	Particulates	Unknown	As appropriate
	SO_2	Probably high	Several
	NOx	High	Catalytic converter
Reheat Furnace	NOx	High	Catalytic converter
Fugitive dust from slag, teeming, etc.	Dust, smoke	Medium	Hoods
Fugitive dust from outside storage	Dust	Minimal (some recovery) (could be great if inside storage)	Spraying

Treatment techniques can be broken down into two types as follows:

- Wet Treatment--The components of these systems are generally first a low energy wet scrubber to eliminate the larger particles followed by either a high energy scrubber or a wet precipitator. Again, depending on the size and scope of the emissions, methodology may vary.

  The use of water to cleanse the air, of course, means that the dust particles are suspended in the water and must be removed by methods described previously. An alternative is to use the water for purposes such as slag cooling where particulates are not a problem. The fact remains, however, that eventually the water must be treated.

- Dry Treatment--This method generally starts out with a mechanical segregator, e.g., cyclone for larger particles and is followed by a baghouse or a dry precipitator.

A combination wet and dry system is possible; one principal restriction being that a dry treatment should not follow a wet one.

These systems are commercially available for varying control levels. The biggest problem (and cost) for the manufacturer is to get the effluent gases to the system (collection hoods, duct work) and in general, to adapt the system to a unique installation circumstance.

It should also be noted that equipment maintenance and operating practices can be controlled in such a way that emissions are minimized. So-called "fugitive dust" which includes not only windblown, but general plant dust can thus be minimized through operating techniques, as well as by wetting down. In addition, during critical periods, i.e., charging or unloading, negative pressures can be introduced to limit escaping air which carries dust.

Factors considered in selecting appropriate abatement techniques assuming equal compliance capabilities include:

- Level of output (care must be taken to design on the basis of maximum not average output)

- Availability of water
- Process and/or raw material characteristics
- Treatment facilities already available
- Competence of the labor pool

(2) Hydrocarbons Are at Present Not Controlled

Hydrocarbons are given off when volatile petroleum products are in contact with air. Basic control techniques could include reducing air exposure and, where necessary, collection and scrubbing of emissions.

(3) Sulfur Vapors Can Be Extracted From Gas in a Number of Ways Chemically, But Costs Would Be High

An alternative is to use coal that is low in sulfur content but this is not always possible due to the limited quantities available. Sulfur is presently not being extracted from gas. An interesting sidelight to sulfur emissions is that if a large proportion of the sulfur that is emitted were reclaimed, it would be enough to supply the entire sulfur needs of the United States.

(4) Oxides of Nitrogen Which Are Produced When Natural Fuels Are Burned Are Not Being Controlled at Present

Industry is experimenting with and perfecting the use of a catalytic converter for this purpose. If required by legislation, it seems clear that the costs involved will be very high.